Kootenai Basin Forecast and Operations for 2015

Joel Fenolio, P.E.

Upper Columbia Senior Water Manager

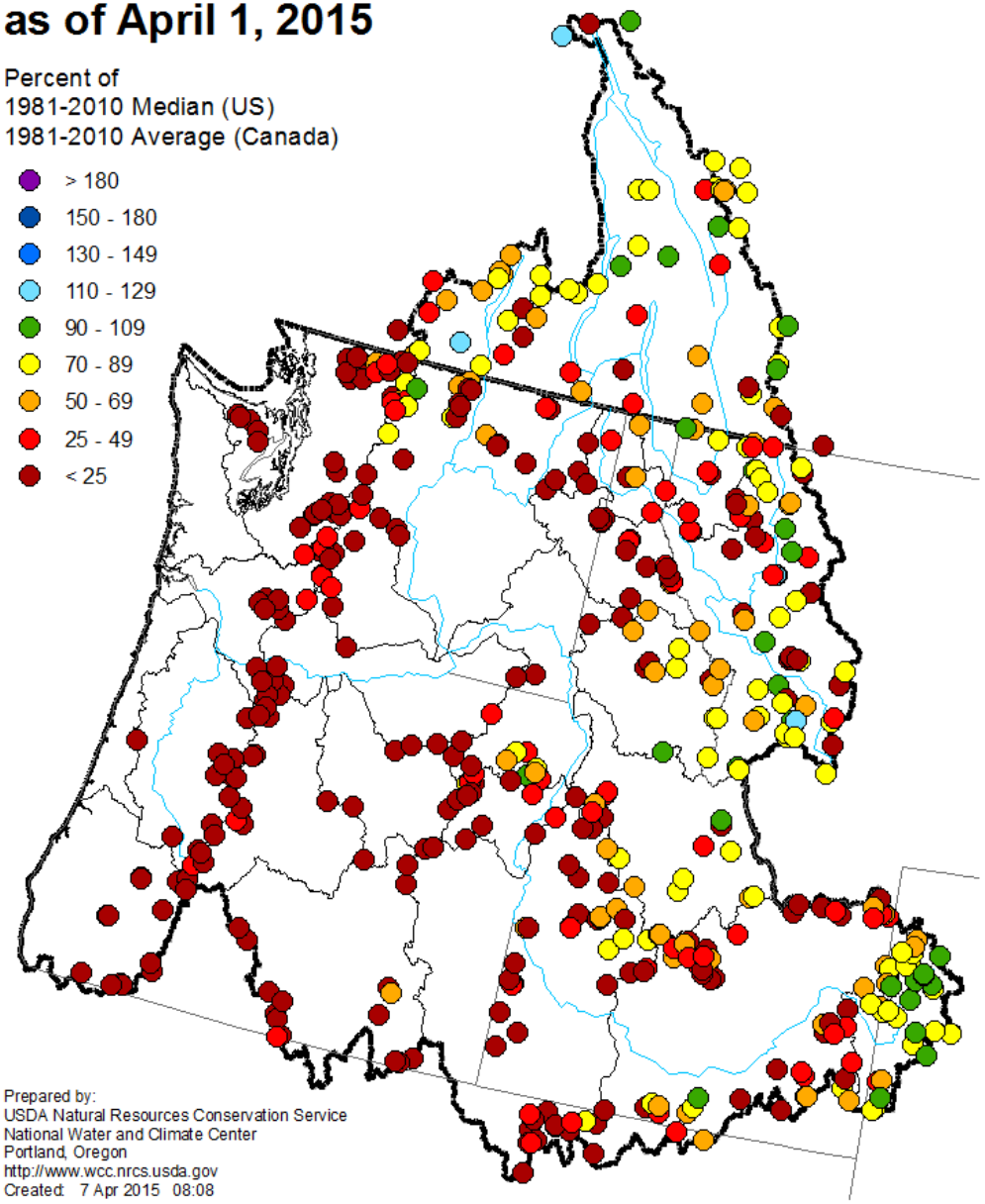
Seattle District

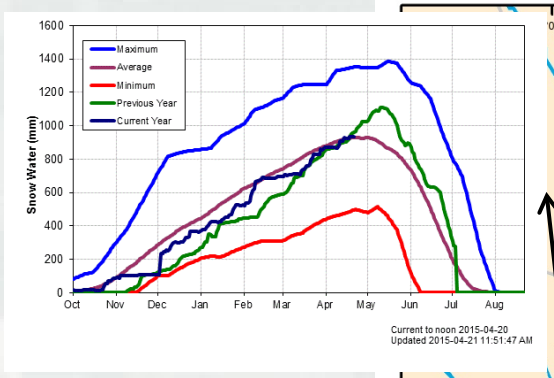
23 Apr 2015

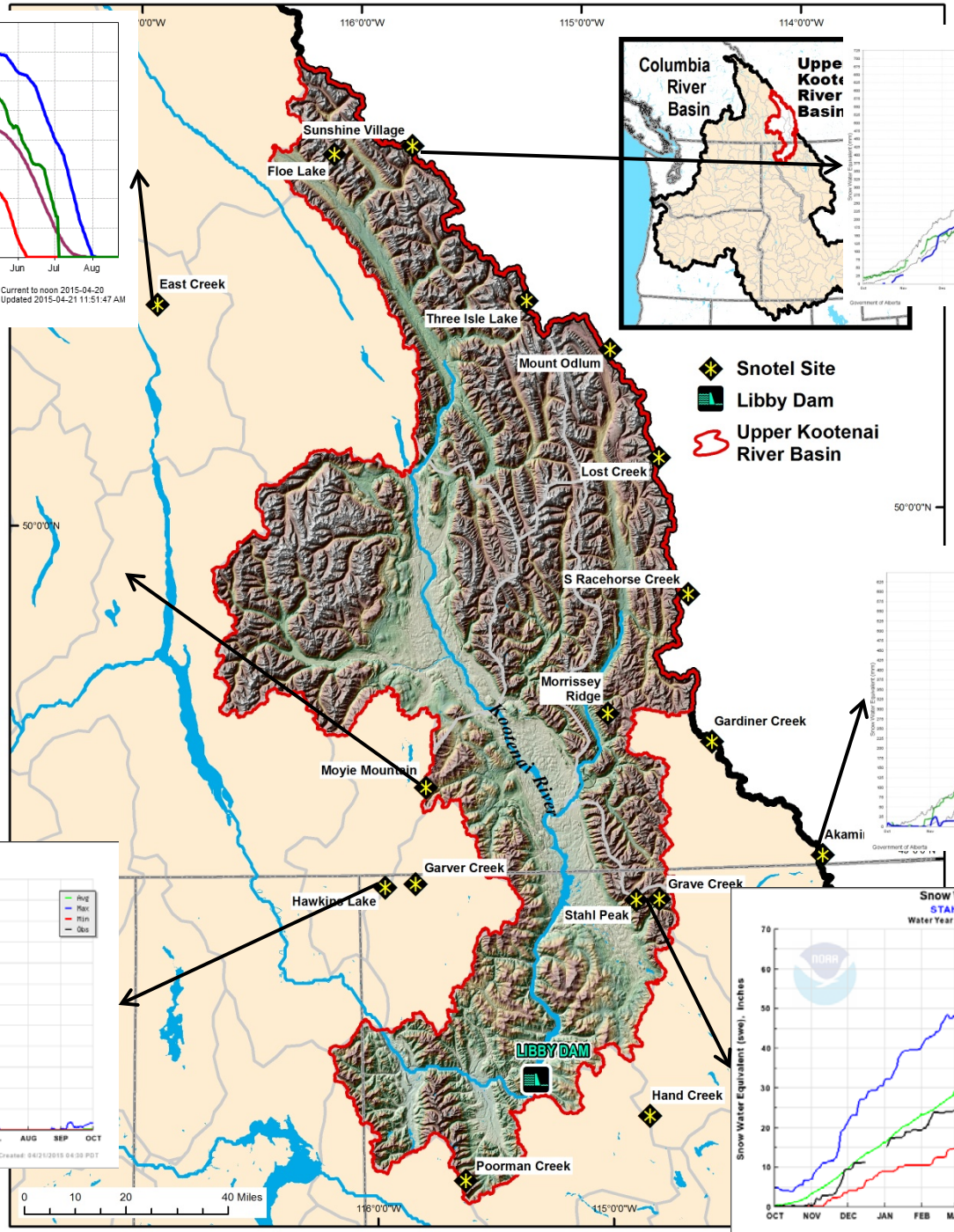
US Army Corps of Engineers

BUILDING STRONG®

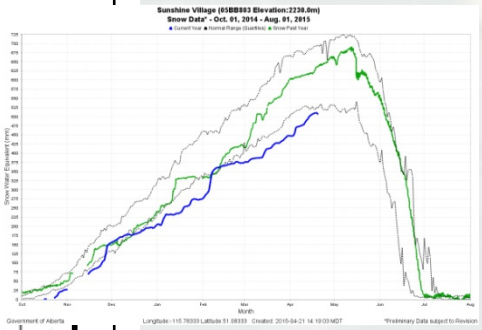
Columbia River and Pacific Coastal Basins Mountain Snowpack as of April 1, 2015

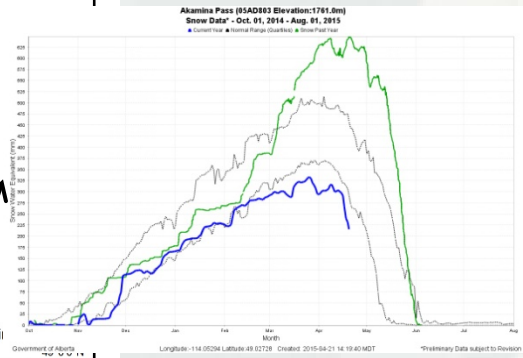


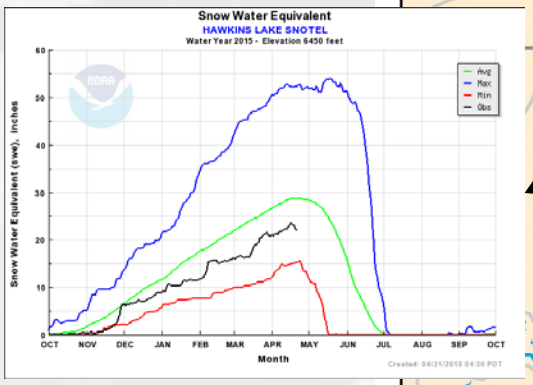

Maximum
Average
Minimum
Previous Year
Current Year
Snow Water (mm)
1600
1400
1200
1000
800
600
400
200
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Current to noon 2015-04-20
Updated 2015-04-21 11:51:47 AM

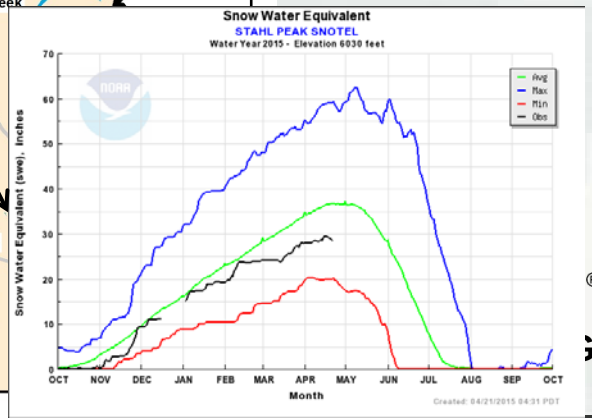

116°0'0"W
115°0'0"W
114°0'0"W
50°0'0"N
Sunshine Village
Floe Lake
East Creek
Three Isle Lake
Mount Odlum
Lost Creek
S Racehorse Creek
Morrissey Ridge
Gardiner Creek
Moyie Mountain
Kootenai River
Garver Creek
Grave Creek
Hawkins Lake
Stahl Peak
LIBBY DAM
Hand Creek
Poorman Creek
Snotel Site
Libby Dam
Upper Kootenai River Basin
0
10
20
40 Miles

Columbia River Basin
Upper Kootenai River Basin


Sunshine Village (05BB803 Elevation:2230.0m)
Snow Data* - Oct. 01, 2014 - Aug. 01, 2015


Akamina Pass (05AD803 Elevation:1761.0m)
Snow Data* - Oct. 01, 2014 - Aug. 01, 2015


Snow Water Equivalent
HAWKINS LAKE SNOTEL
Water Year 2015 - Elevation 6450 feet
Snow Water Equivalent (swe), inches
Month
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT


Snow Water Equivalent
STAHL PEAK SNOTEL
Water Year 2015 - Elevation 6030 feet
Snow Water Equivalent (swe), inches
Month
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT

Libby Water Supply Forecast

Data for Water Year: 2015

Data Station (click on hyperlink)	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014	July 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014	Jan 2015
Climate Data													
SOI						0.20	-0.20						
		0.9											

Data Station (click on hyperlink)	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Data Units	Station Number	Station ID
Precipitation Data (mm & inches)											
Eureka RS, MT	0.55	2.42	1.22	1.21	0.65	2.13			inch	242827	EURM
or alt website for Eureka RS	50%	192%	116%	133%	103%	242%	0%	0%			
West Glacier, MT	2.64	5.77	4.07	3.08	2.58	3.31			inch	245015	LIBM
or alt website for West Glacier	95%	178%	136%	94%	137%	141%	0%	0%			
Cranbrook A, BC	29.40	53.60	25.50	22.90	20.2	47.10			mm	248809	WGLM
	125%	149%	81%	92%	105%	194%	0%	0%			
Fernie, BC	126.9	273.0	95.0	93.00	81.0	194.6			mm	1152850	FNEB
	114%	175%	97%	72%	105%	193%	0%	0%			

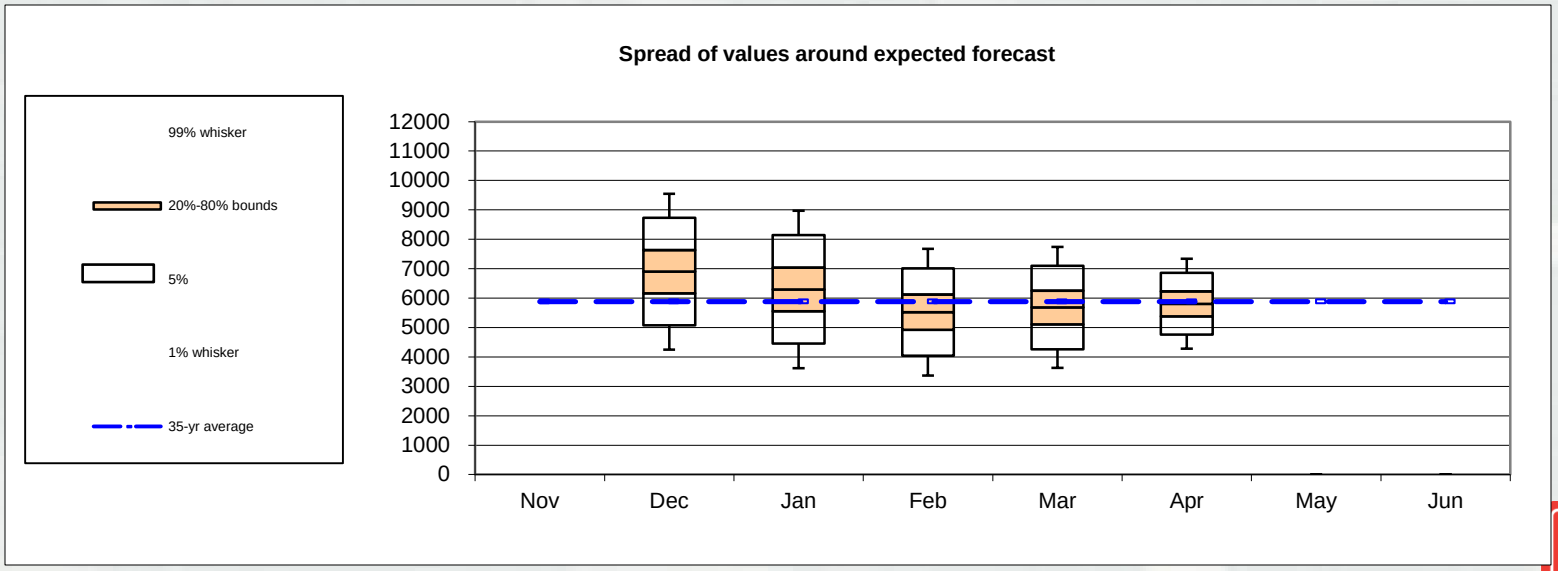
Data Station (click on hyperlink)	1-Jan 2015	1-Feb 2015	1-Mar 2015	1-Apr 2015	1-May 2015	1-Jun 2015	Data Units	Station Number	Station ID	Elevation (feet)
Snow Water Equiv (First of Month values)										
Hawkins Lake, MT		11.8	15.9	21.1			inch	05BB803	SUNS	7300
		72%	79%	84%	0%	0%				
Stahl Peak, MT	15.1	19.1	24.1	27.9			inch	2D08P	EACH	7992
	93%	81%	84%	80%	0%	0%				
East Creek, BC		537.0	706.0	872.0			mm	14A12S	STAM	6030
		88%	100%	101%	0%	0%				
Moyie Mountain, BC	131.0	193.0	228.0	265.0			mm	05BF824	TISL	7100
	73%	67%	64%	62%	0%	0%				
Sunshine Village, AB	200.0	266.0	372.0	447.0			mm	05BL811	LOST	7100
	73%	69%	80%	79%	0%	0%				
Akamina Pass, AB		230.0	290.0	293.0			mm	2C09Q	MORB	7087
		72%	74%	63%	0%	0%				
South Racehorse Creek, AB		234.0	303.0	376.0			mm	15A03S	HAWM	6450
		83%	88%	88%	0%	0%				

Streamflow (KAF)	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun				
Libby Inflow Volume			220.57	335.41	485.16				KAF	12301920	LIBQIDR	1445
			99%	177%	197%	0%	0%	0%				

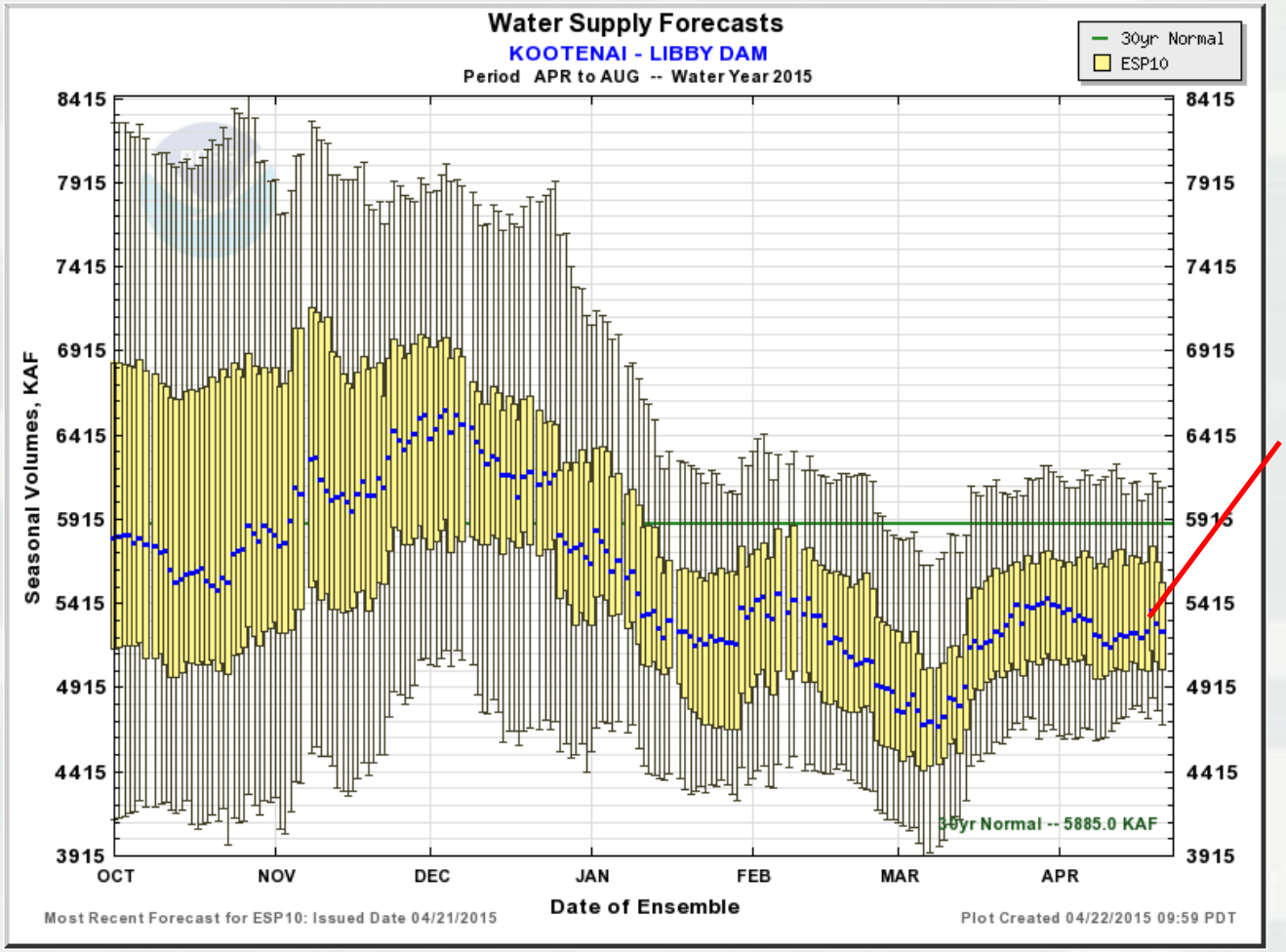
Reservoir Elevation (feet)	1-Nov	1-Dec	1-Jan	1-Feb	1-Mar	1-Apr	1-May	1-Jun				
Libby FOM Elev	2448.5	2435.3	2410.6	2409.8	2412.9	2419.2			KAF	12301920	LIBHFDR	1445

Winter 2015
Hydrologic Conditions

- Current Apr-Aug inflow for Libby Dam
  - 5808 KAF (99% of average)



ESP Traces



Median ESP Trace 5.2 MAF

Winter 2015
Hydrologic Conditions

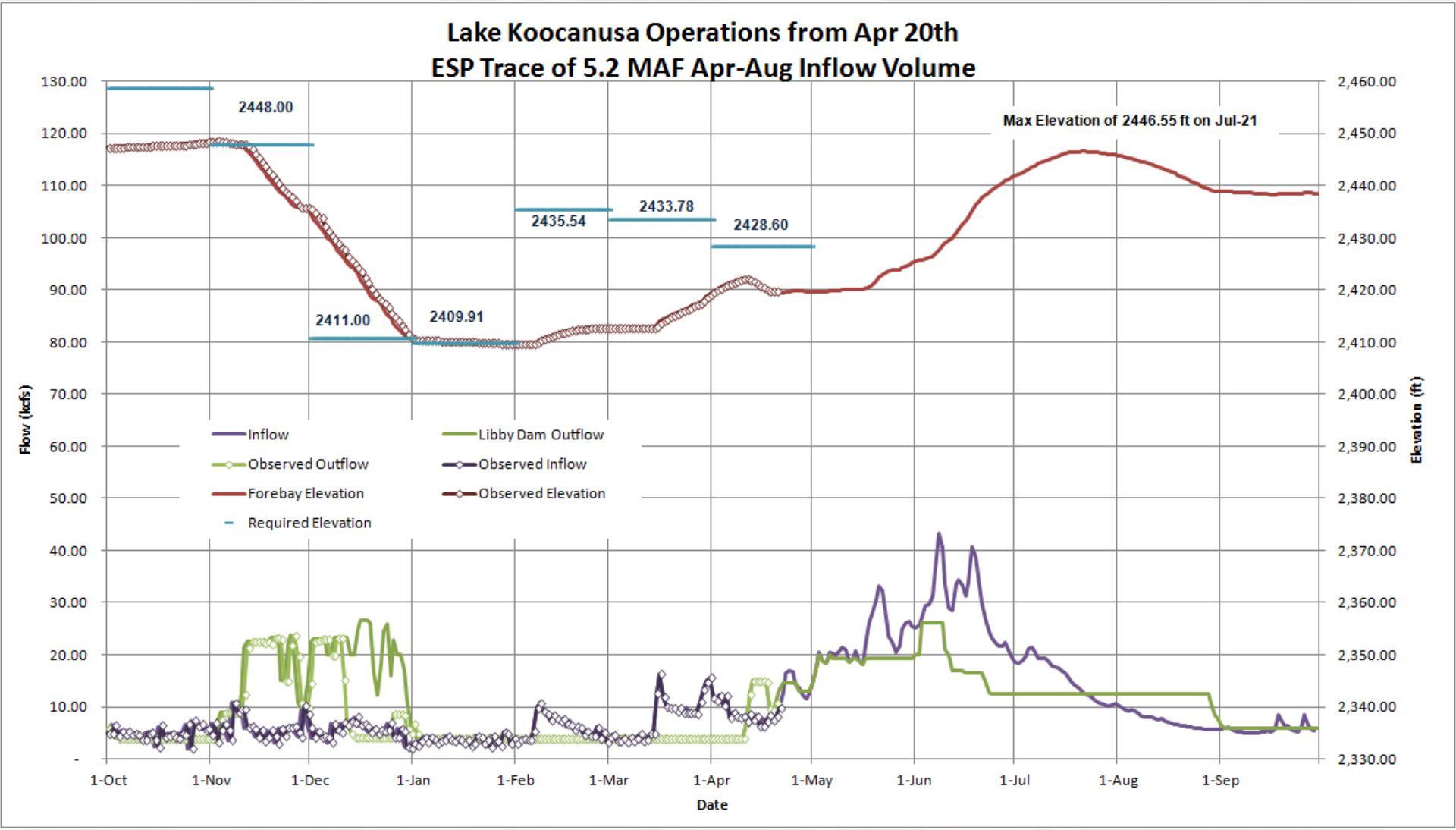
- Below average snowpack
- 130% of average precipitation in upper Kootenai Watershed
- Higher temperatures than normal causing low snowpack with above average precipitation
  - Inflow to Libby Jan through Mar 157% of average

Libby Dam Basics

- Provides local and system flood control
- Max. flood control draft = 4.98 MAF (El. 2287 ft.)
- Fixed end-of-December draft = 2.0 MAF (El. 2411 ft.)
  - Allows Libby Dam to meet its 31 Mar flood control space using the powerhouse.
- Full pool is El. 2459 ft.

Libby Dam Operations

- Current Elevation is 2419.8 ft (~1.6 MAF of Space)
  - Full pool is 2459 ft
  - End of month requirement is 2428.6 ft
- Operating to target 2420 ft end of April (releasing 13 kcfs)
- Upcoming Operations
  - Sturgeon Pulse
    - No spill
    - May come as early as mid May
    - Peak powerhouse releases of 14 days
  - Summer Operations
    - Summer draft to target 2439 or 2449 ft end of August

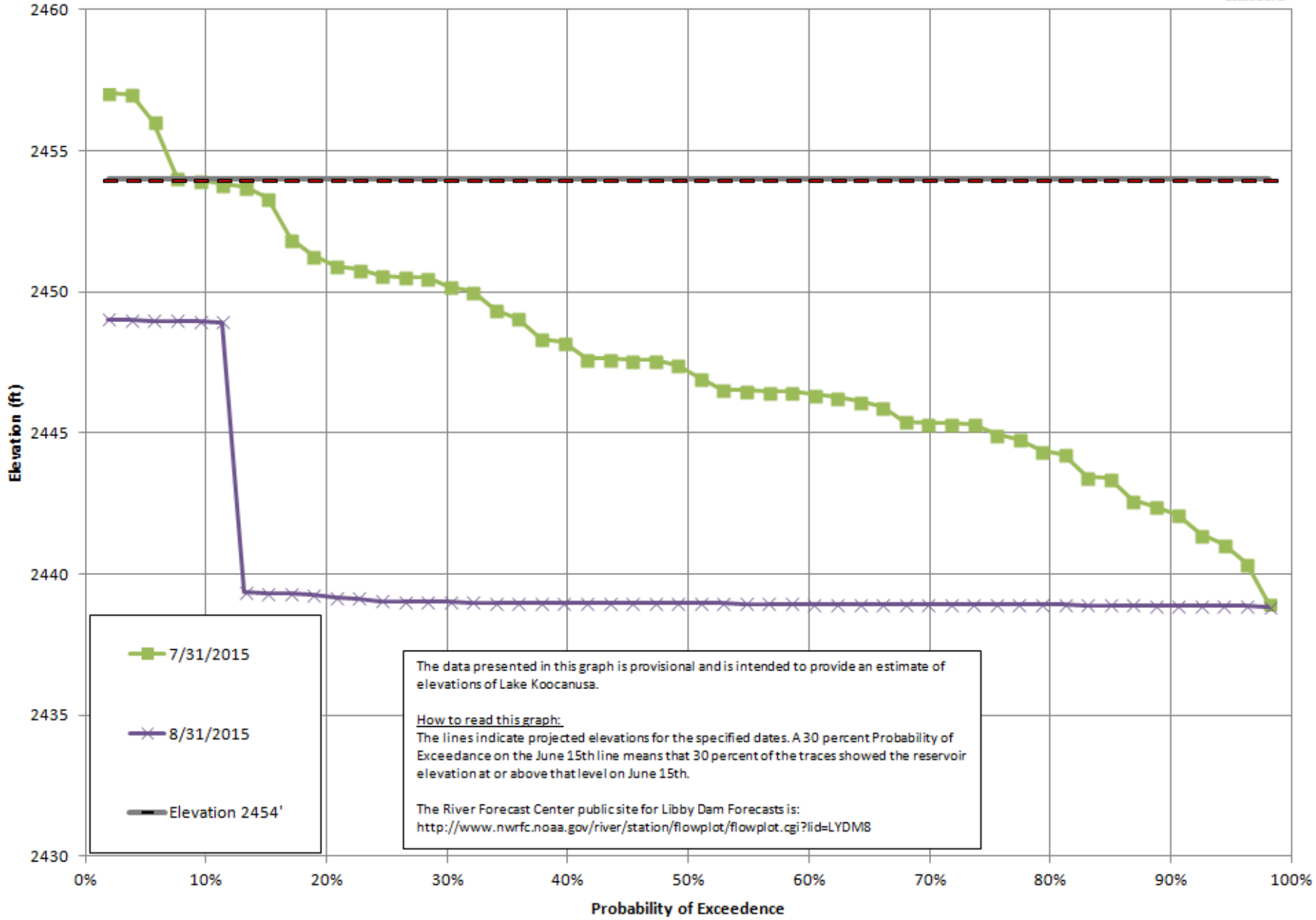

Lake Koocanusa Operations from Apr 20th
ESP Trace of 5.2 MAF Apr-Aug Inflow Volume
Max Elevation of 2446.55 ft on Jul-21
2448.00
2411.00
2409.91
2435.54
2433.78
2428.60
Inflow
Libby Dam Outflow
Observed Outflow
Observed Inflow
Forebay Elevation
Observed Elevation
Required Elevation
Flow (kcfs)
Elevation (ft)
Date
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
2,460.00
2,450.00
2,440.00
2,430.00
2,420.00
2,410.00
2,400.00
2,390.00
2,380.00
2,370.00
2,360.00
2,350.00
2,340.00
2,330.00
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

Modeled using current ESP traces as of 04/20/15

Libby Dam Reservoir Elevations - Probability Chart

Corps of Engineers Projections Based on the 53 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District

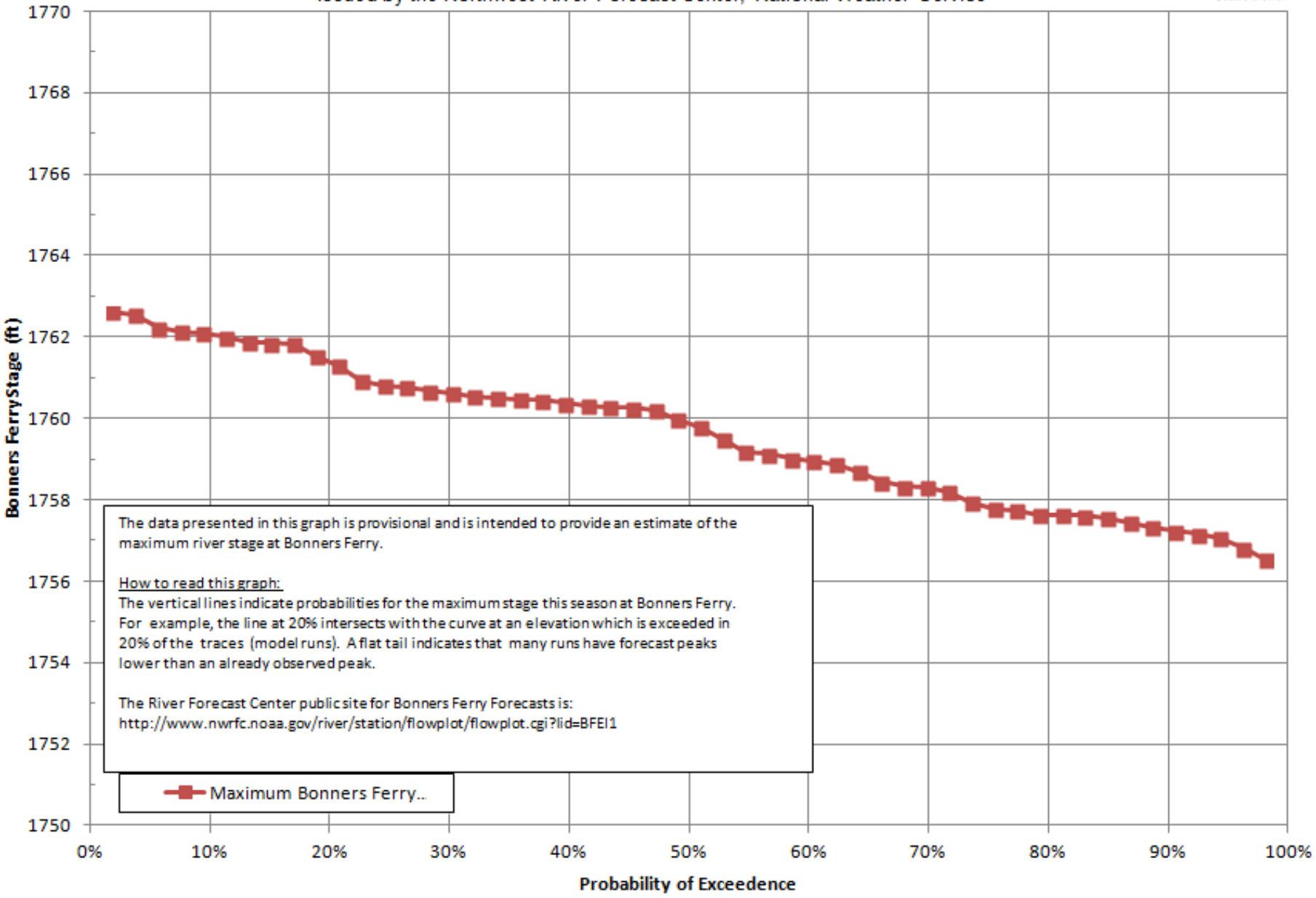


Modeled using current ESP traces as of 04/20/15

Maximum April-August Bonners Ferry Stage - Probability Chart

Corps of Engineers Projections Based on the 53 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District



The data presented in this graph is provisional and is intended to provide an estimate of the maximum river stage at Bonners Ferry.

How to read this graph:
The vertical lines indicate probabilities for the maximum stage this season at Bonners Ferry. For example, the line at 20% intersects with the curve at an elevation which is exceeded in 20% of the traces (model runs). A flat tail indicates that many runs have forecast peaks lower than an already observed peak.

The River Forecast Center public site for Bonners Ferry Forecasts is:
http://www.nwrfc.noaa.gov/river/station/flowplot/flowplot.cgi?lid=BFEI1

Summary

- Hard year to forecast above average precipitation but low snowpack
- ESP traces and Corps Regression equation in slight disagreement
- Flood Risk low based on lack of snowpack that feeds tributaries below Libby Dam
- Refill (above 2450 feet), if draft requirement to 2439 feet is triggered, looks to be unlikely

RECLAMATION

Managing Water in the West

2015 Operations for Western Montana Projects

U.S. Department of the Interior
Bureau of Reclamation

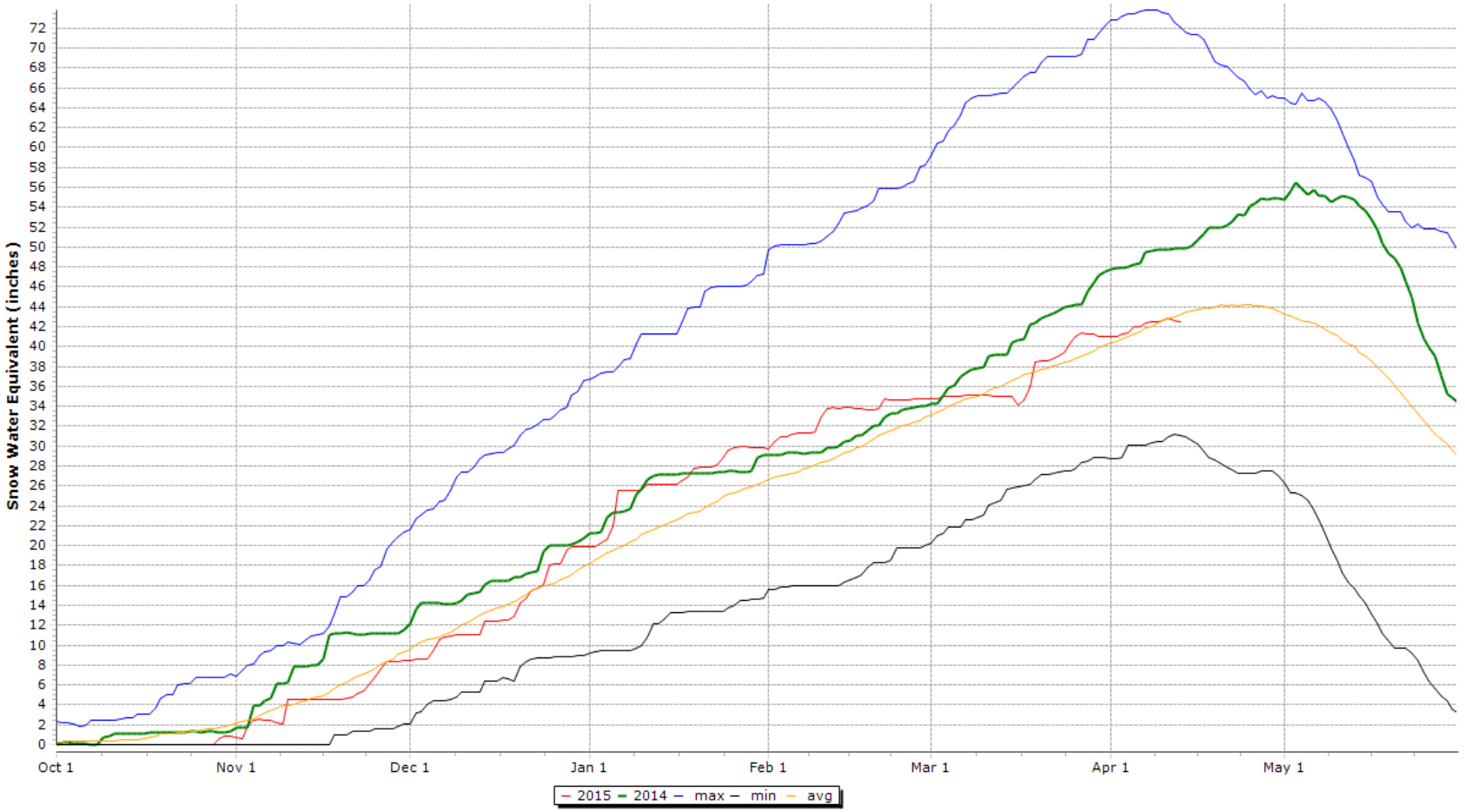
Hungry Horse Reservoir

RECLAMATION

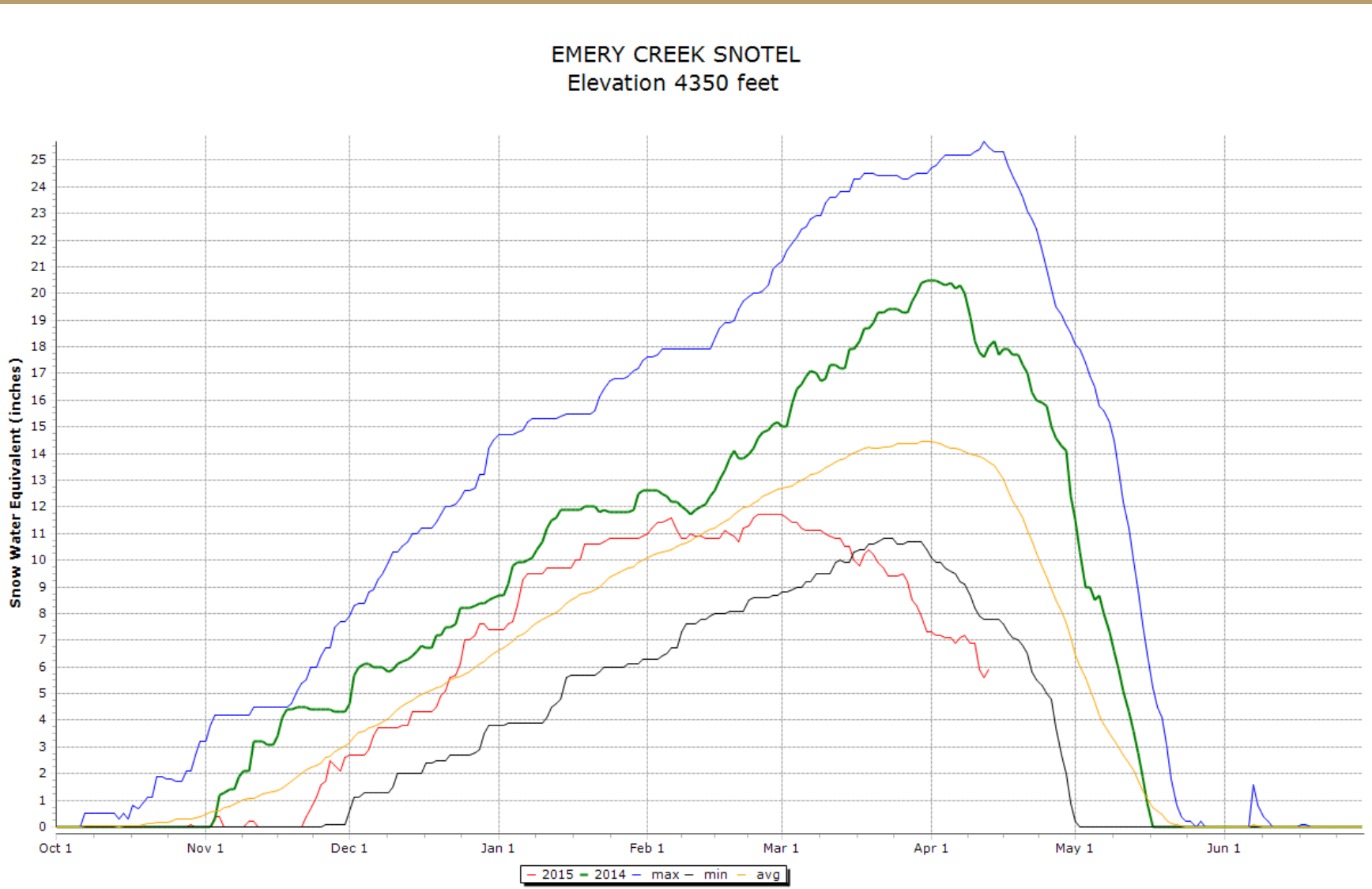
- April Final Runoff Forecast for Hungry Horse inflow is 1653 kaf (Apr-Jul) which is 88% of average.

- Hungry Horse discharges currently at 5600 cfs. In May discharges will average around 6600 cfs, refill is expected in early July.

- Hungry Horse will be operated to control flooding at Columbia Falls approaches flood stage.
- Current conditions indicate that the summer drawdown will be 20ft by end of September.

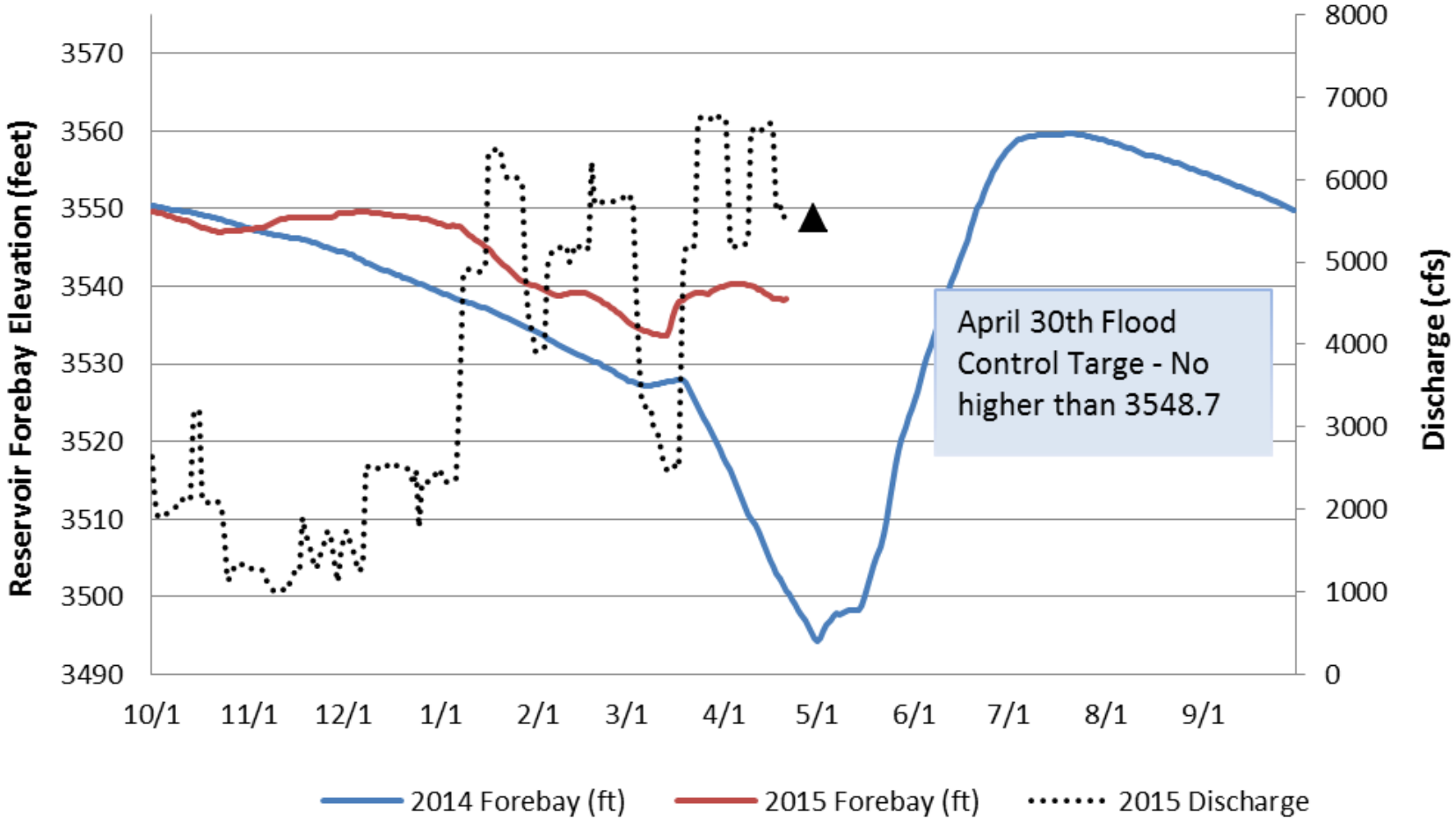


RECLAMATION



RECLAMATION

Hungry Horse Operations (WY 2015)



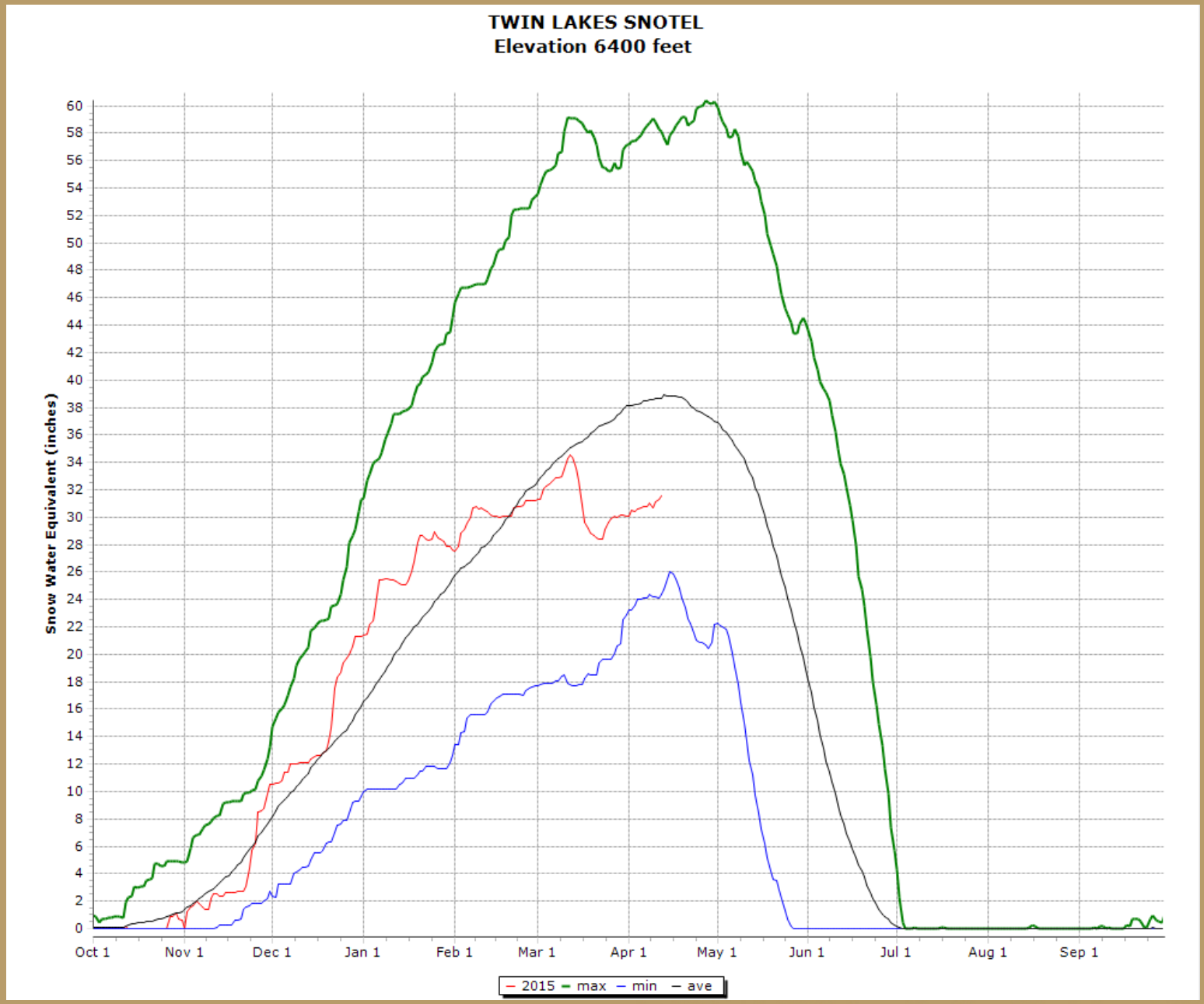
RECLAMATION

Lake Como

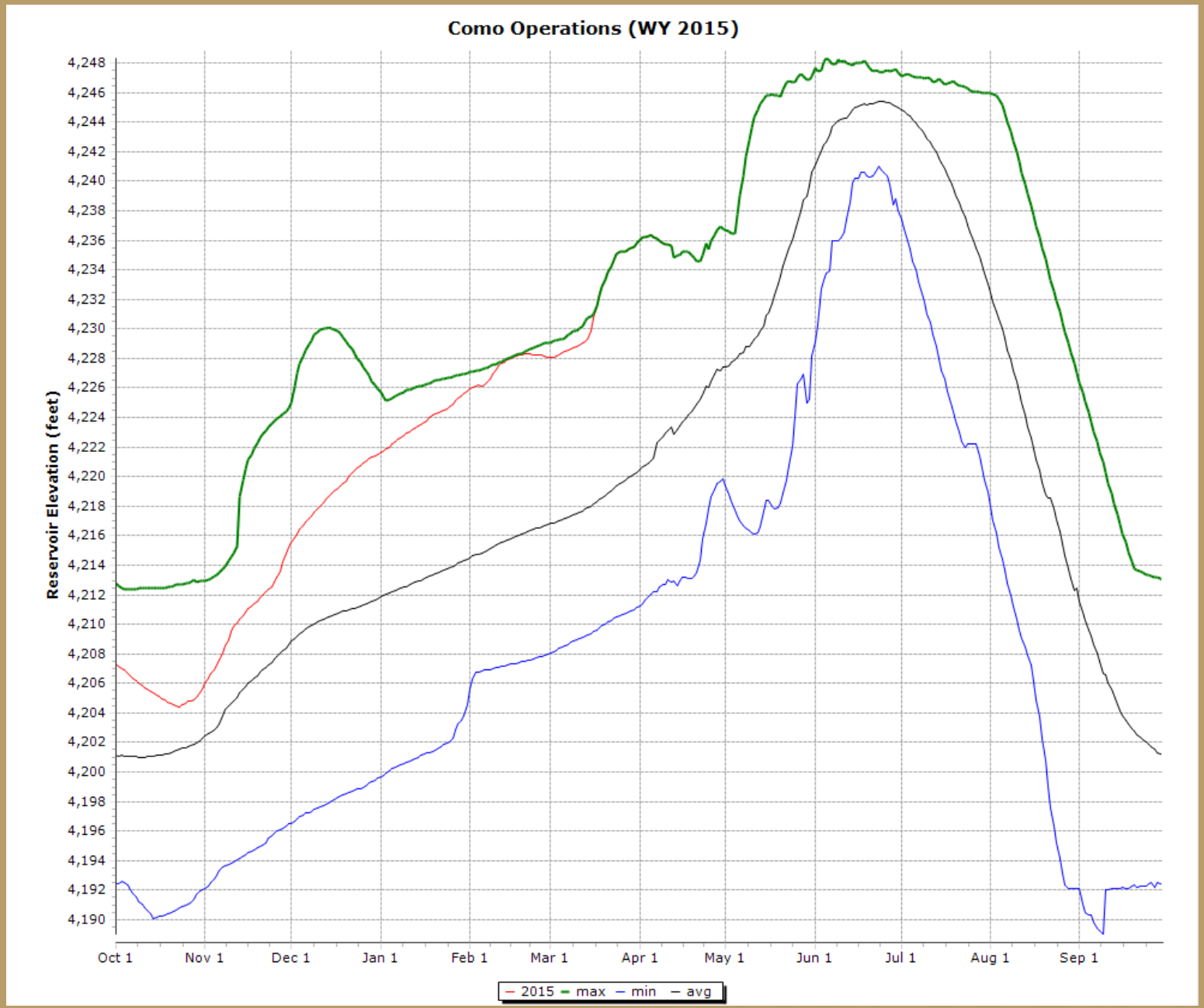
RECLAMATION

- NWRFC latest forecast (4/13) for the Bitterroot River near Darby is 85% of average.

- Snow water at Twin Lakes Snotel is currently at 88% of median for this date.



RECLAMATION



RECLAMATION

Summary

- Below average snow and water supply for Hungry Horse and Como.

- Both Hungry Horse and Como expected to refill, Como by early June and Hungry Horse in early July.

CLARK FORK & KOOTENAI RIVER BASINS WATER PLAN

A presentation of the Clark Fork Task Force

DEVELOPING THE CLARK FORK BASIN AND STATE WATER PLANS

2013: *DNRC launches Montana State Water Supply Initiative under direction from State Legislature.*

Clark Fork Task Force launches 18-month planning process.

PHASE 1: *Public scoping – select membership of Clark Fork Basin Task Force; conduct public scoping; ID priority issues.*

PHASE 2: *Information transfer – presentations on topics related to priority issues.*

PHASE 3: *Recommendation development – draft recommendations, conduct public review, publish final report.*

PLAN CONTENT GOALS

- *An inventory of consumptive and nonconsumptive uses with existing water rights;*
- *An estimate of the amount of surface and ground water to satisfy new future demands;*
- *Analysis of the effects of frequent drought and new or increased depletions on the availability of future water supplies;*
- *Proposals for the best means to satisfy existing water rights and new water demands;*
- *Possible sources of water to meet the needs of the state; and*
- *Any legislation necessary to address water resource concerns.*

WATER USE IN MONTANA

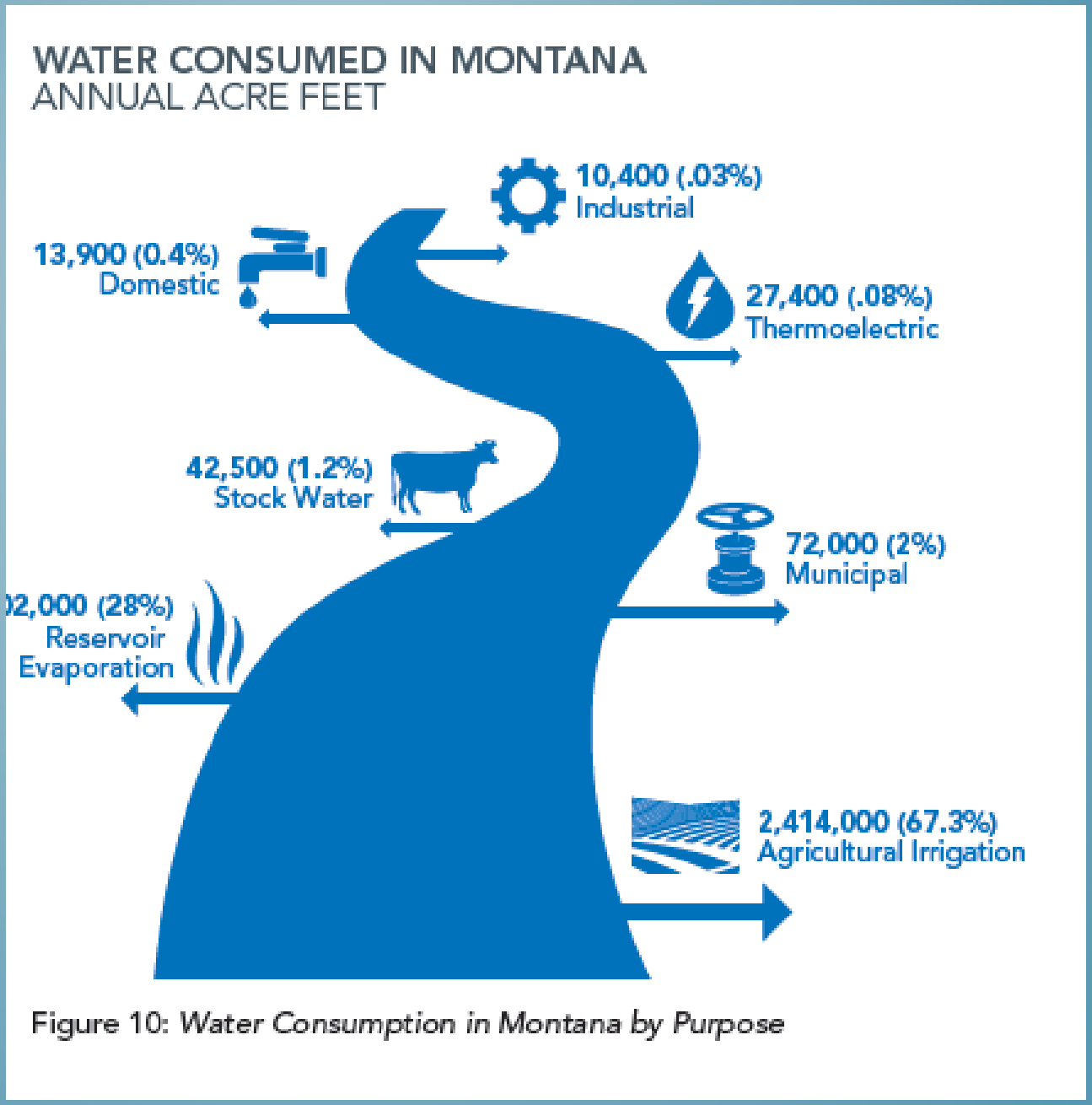
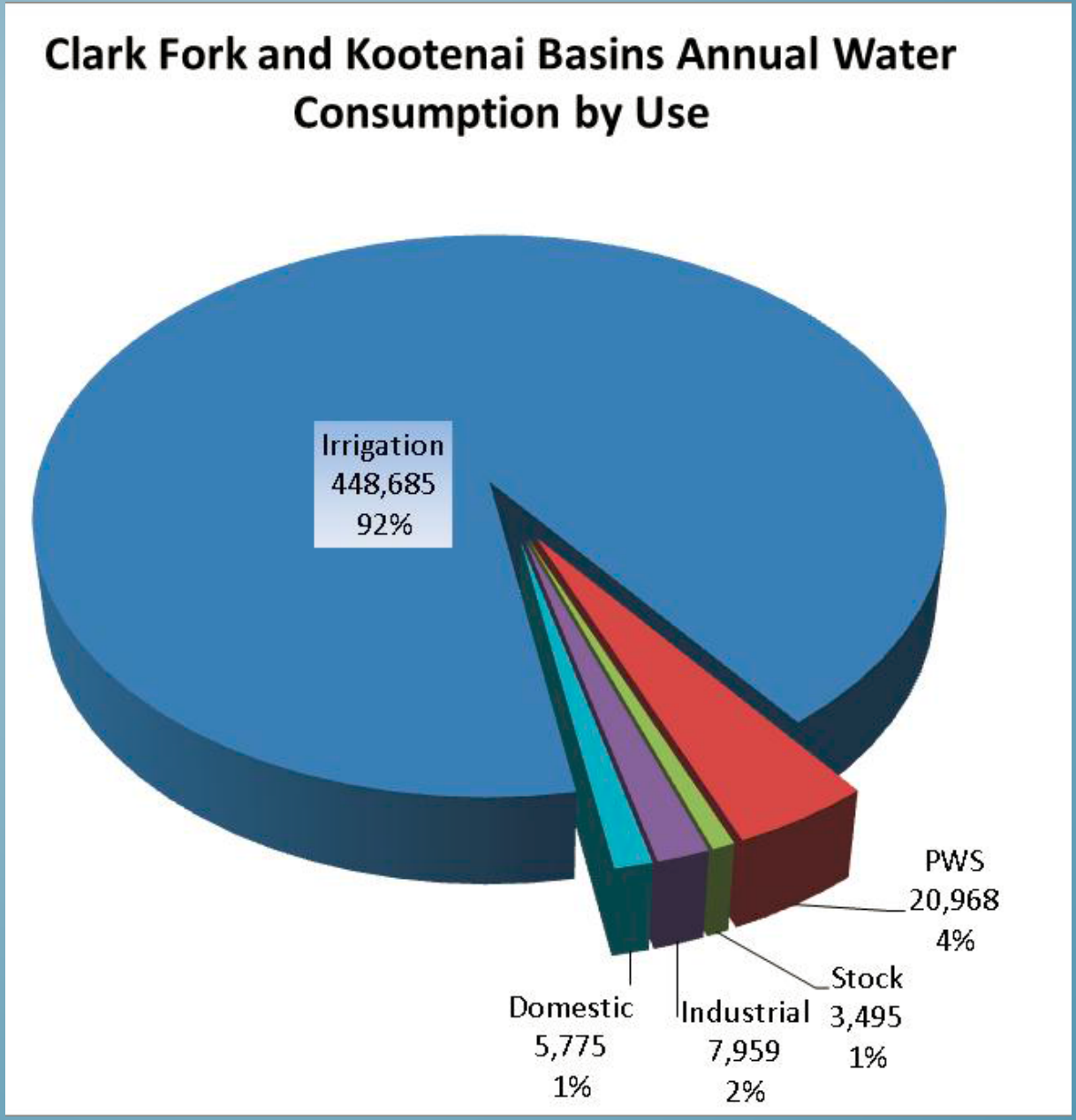


Figure 10: *Water Consumption in Montana by Purpose*

BASIN WATER RESOURCES

Describing the Basin:

- *Water uses*
- *Climate trends*
- *Legal availability*
- *Water quality*
- *Stream health*
- *Water storage*
- *Water consumption*



BASIN WATER PRIORITIES

At 6 public meetings held across the Clark Fork-Kootenai Basin, stakeholders identified priority issues. These issues fell into 21 categories.

- Aquatic Invasive Species
- Climatic Changes
- Drought Readiness
- Federal Regulation of Water
- Fisheries & Instream Flow
- Gages & Monitoring
- Groundwater Wells
- Growth & Development
- Indian & Federal Reserve
- Water Rights
- Infrastructure & Irrigation
- Recreation
- Riparian Areas
- Water Availability
- Water Conservation & Efficiency
- Water Marketing
- Water Planning
- Water Quality
- Water Rights Change Process
- Water Rights Enforcement
- Water Storage

ISSUE 1: MAINTAINING WATER AVAILABILITY

GOAL 1: *Implement measures that improve the ways in which we manage and conserve water resources.*

GOAL 2: *Better understand surface water and groundwater resources and the potential for future natural and human changes to those resources.*

GOAL 3: *Facilitate collaborative responses to issues of water availability.*

Recommendations Highlights:

- Encourage & support water conservation measures from all types of water users.
- Expand efforts to gather best scientific information to understand water availability.
- Increase collaboration among stakeholders to address water availability.

ISSUE 2: ENSURING NATURAL SYSTEMS HEALTH

GOAL 1: *Restore and/or maintain surface water flows and groundwater levels needed to protect natural systems health over seasonal and long-term climate cycles.*

Recommendations Highlights:

- Establish state agency partnerships to address flow-related impairments.
- Restore, maintain and add natural storage.
- Encourage more coordination between DNRC and local watershed groups to implement flow restoration projects.
- Build programs and partnerships to reduce the risk of aquatic invasive species.

ISSUE 3: WATER RIGHTS ADMINISTRATION, PROTECTION & ENFORCEMENT

GOAL 1: *Maintain a system and a process for changing existing water rights and allowing new water rights that both protects existing water rights while providing a transparent, coherent and expeditious process for reviewing proposed water rights, changes and new uses.*

GOAL 2: *Protect water rights through enforcement of existing rights.*

Recommendations Highlights:

- Ensure consistency and clarity in water rights change process.
- Adopt strategies in lieu of litigation to solve water rights disputes.
- Determine accuracy of water rights claims to understand physical and legal water availability.

ISSUE 4: MEETING FUTURE WATER DEMAND

GOAL 1: *The availability of water in Montana to meet future demands is supported by a concise, predictable and defensible legal framework.*

GOAL 2: *Montana actively pursues the development of water resources to meet future water demands with specific attention given to spatial and temporal seasonality of those resources and the associated demand.*

GOAL 3: *Montana meets future demand through education, outreach and a shared understanding of the importance of water to the economic, social and environmental well-being of the citizens of Montana.*

Recommendations Highlights:

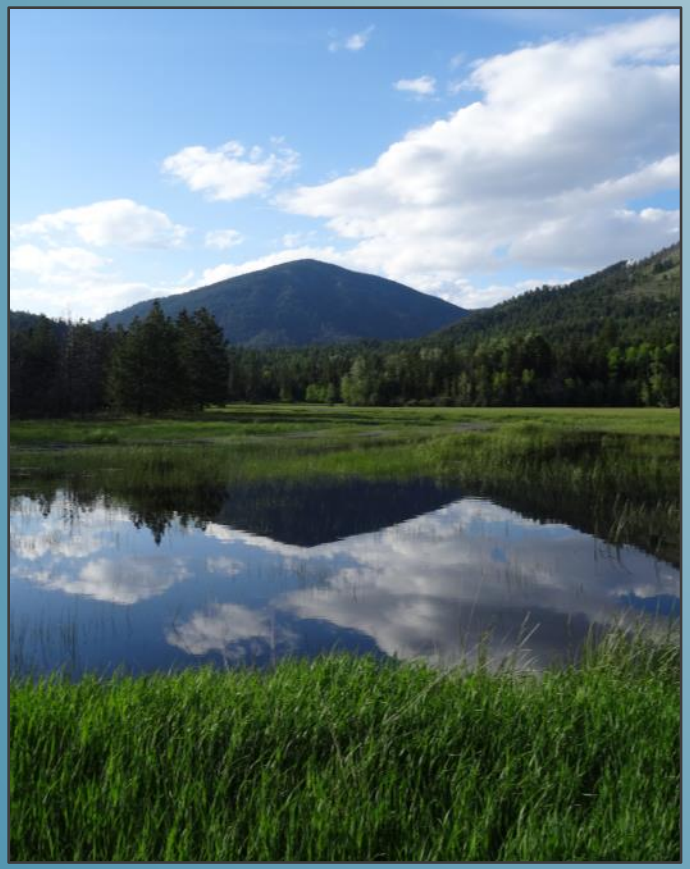
- Encourage conservation measures while protecting water rights.
- Analyze water availability in context of existing laws and determine if they need to be changed.
- Invest in community education on water availability.

CONTINUE WATER USE COUNCILS

The Task Force recommended the permanent authorization of basin advisory councils and state support of those councils. The councils would:

- *Help implement and modify the basin plans.*
- *Make recommendations on proposed changes to state water management.*
- *Organize symposia on water supply forecasts.*
- *Develop educational materials on water topics.*

HOW ARE WE ADAPTING?



With the changes that are happening and predicted, how does the basin plan respond?

- *Supporting water use efficiency & conservation.*
- *Improving understanding of water supply.*
- *Increasing flexibility on how we manage water.*
- *Integrating more focus on natural storage.*
- *Supporting drought preparedness and local watershed planning/response.*
- *Improving connected management of surface and ground water.*
- *Encouraging and supporting more collaboration, local watershed groups, community-based action.*

FOR MORE INFORMATION

To view the Clark Fork & Kootenai River Basin Plan or the Montana State Water Plan, please visit:

http://dnrc.mt.gov/divisions/water/management/state-water-plan

DNRC State Water Projects

2015 Reservoir Storage Outlook
Western Montana

Larry A. Schock
Missoula Regional Office
Water Resources Division

DNRC State Water Projects Bureau
Western Montana Reservoirs

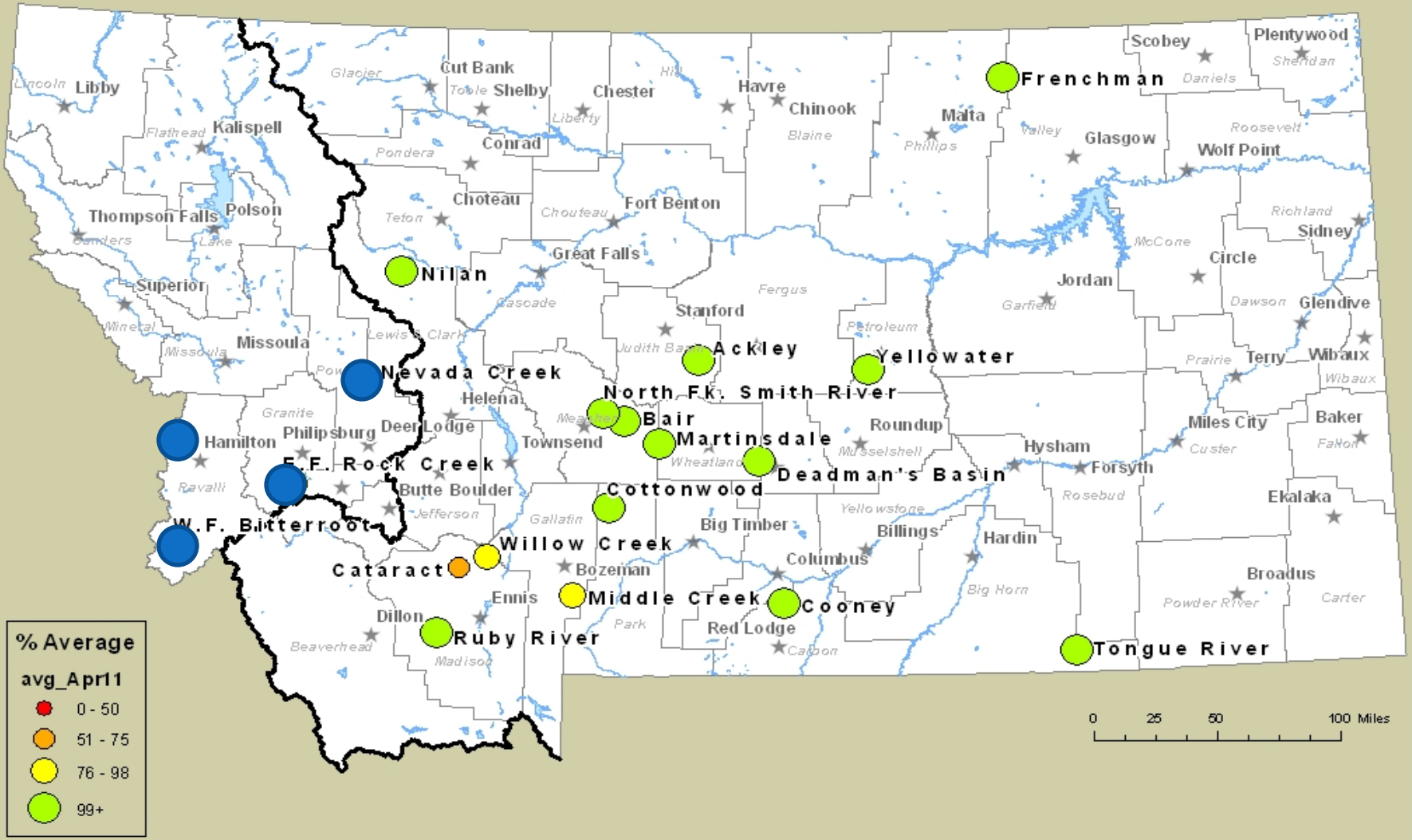
East Fork of Rock Creek Dam

Fred Burr Dam

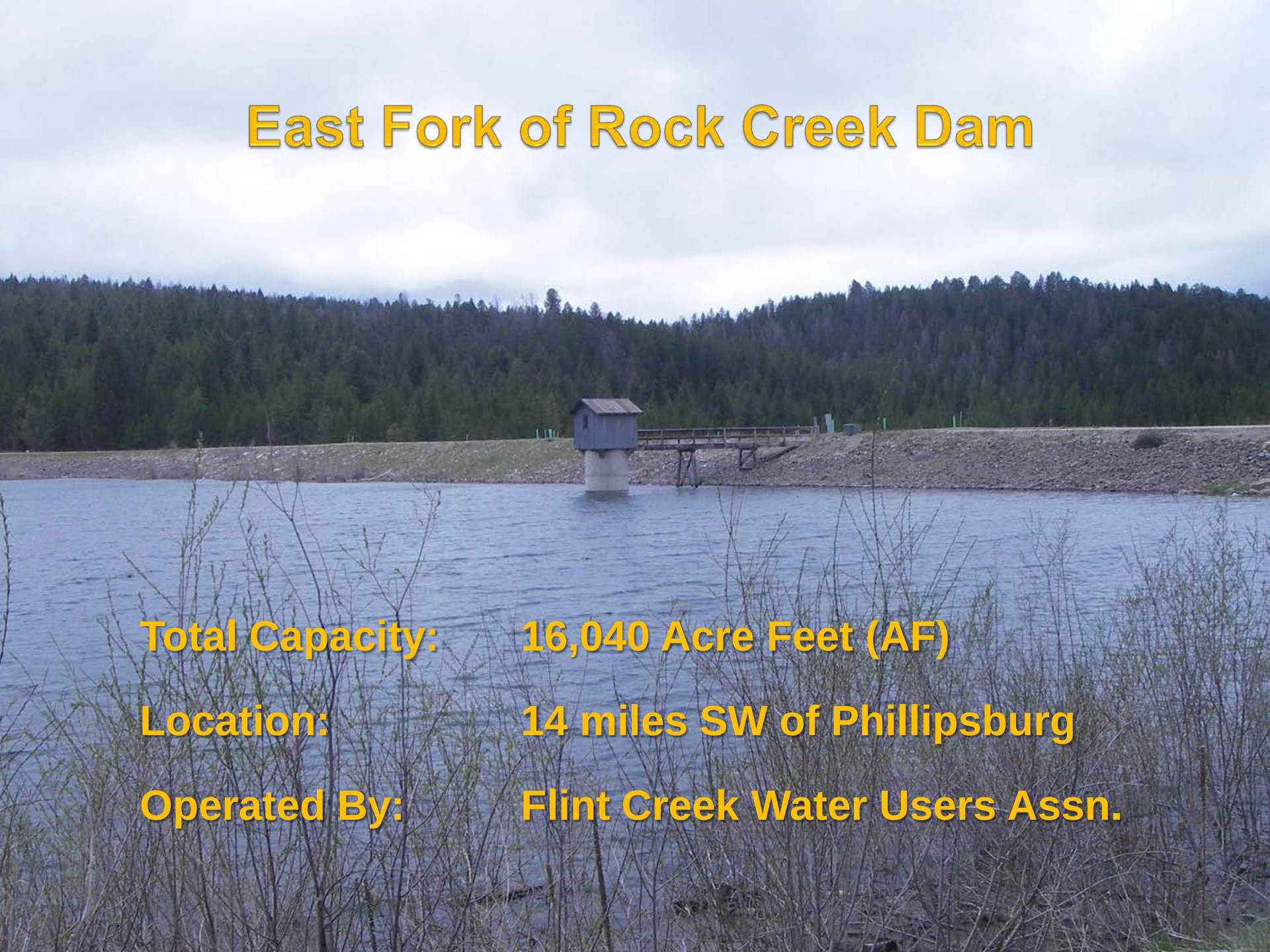
Nevada Creek Dam

Painted Rocks Dam

DNRC State Water Project Dams



East Fork of Rock Creek Dam

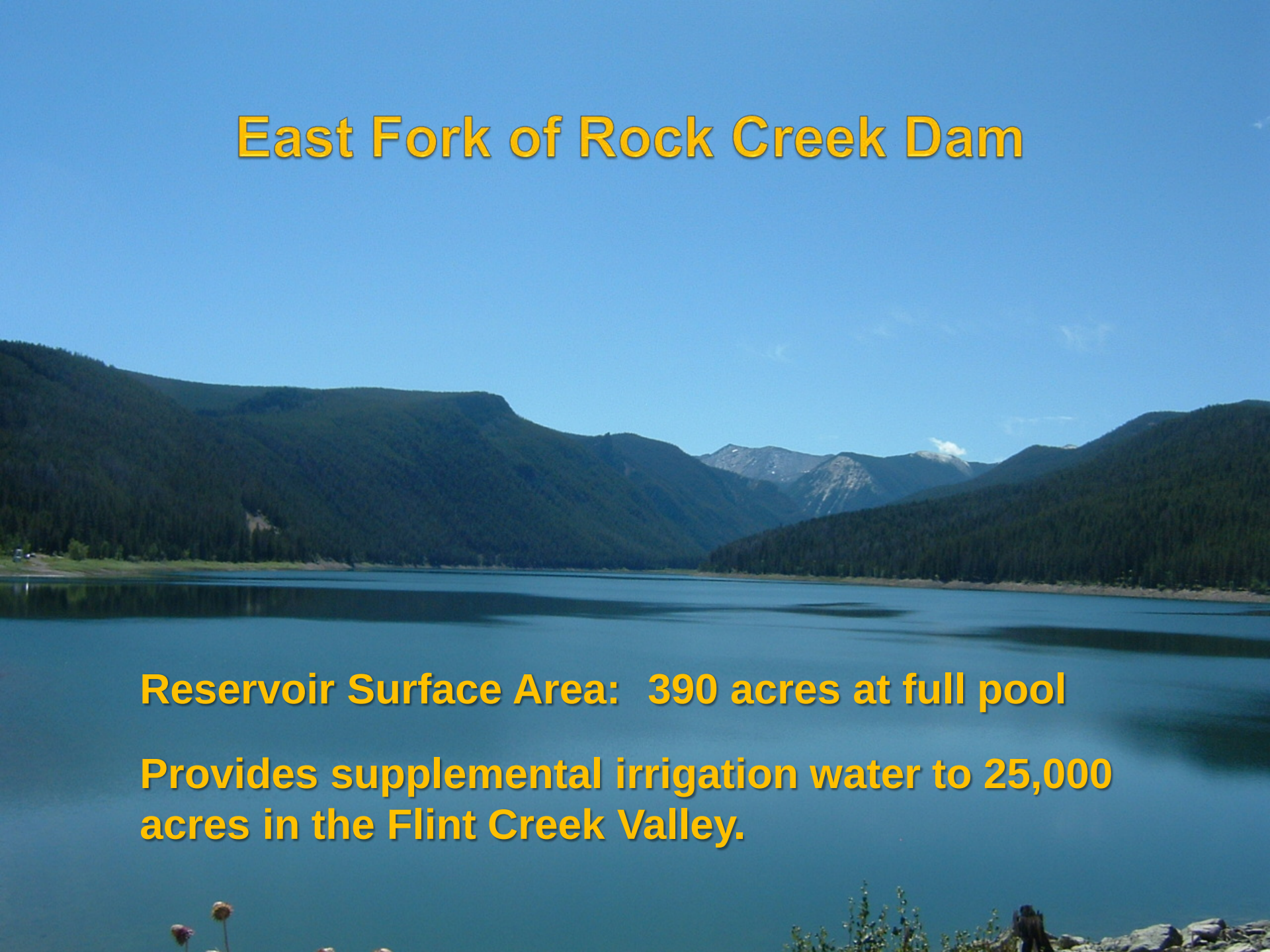


Total Capacity: 16,040 Acre Feet (AF)

Location: 14 miles SW of Phillipsburg

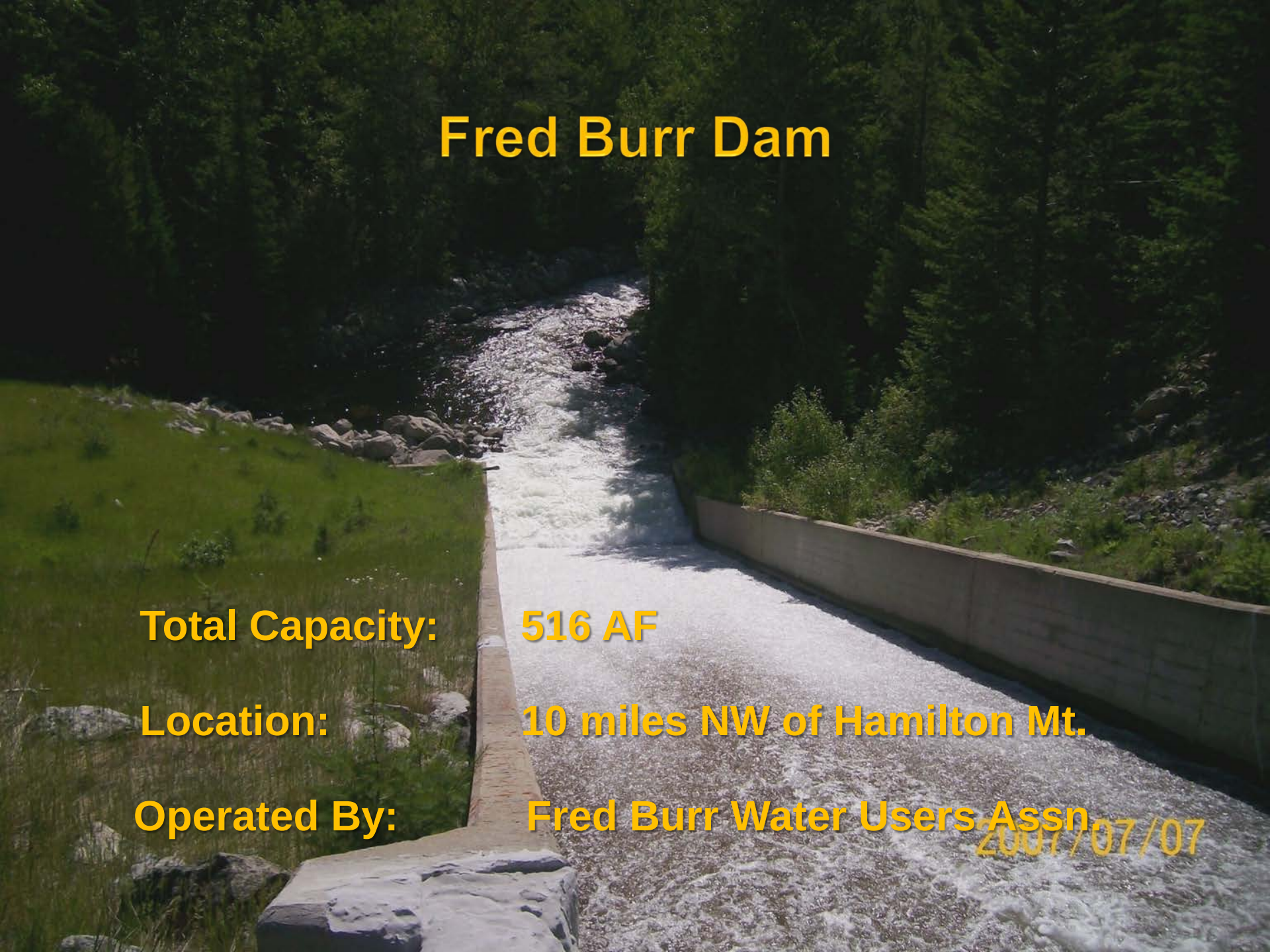
Operated By: Flint Creek Water Users Assn.

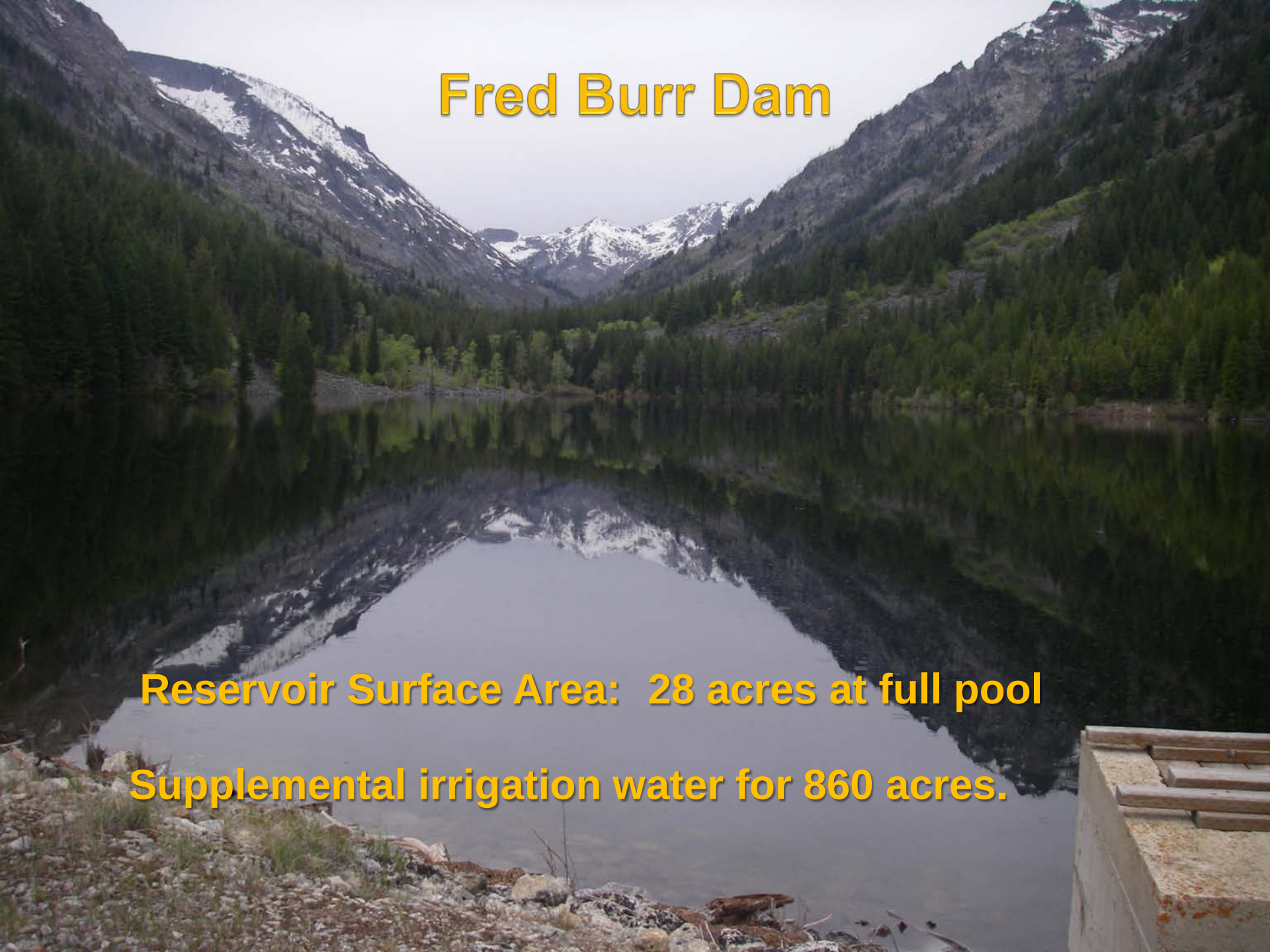
East Fork of Rock Creek Dam

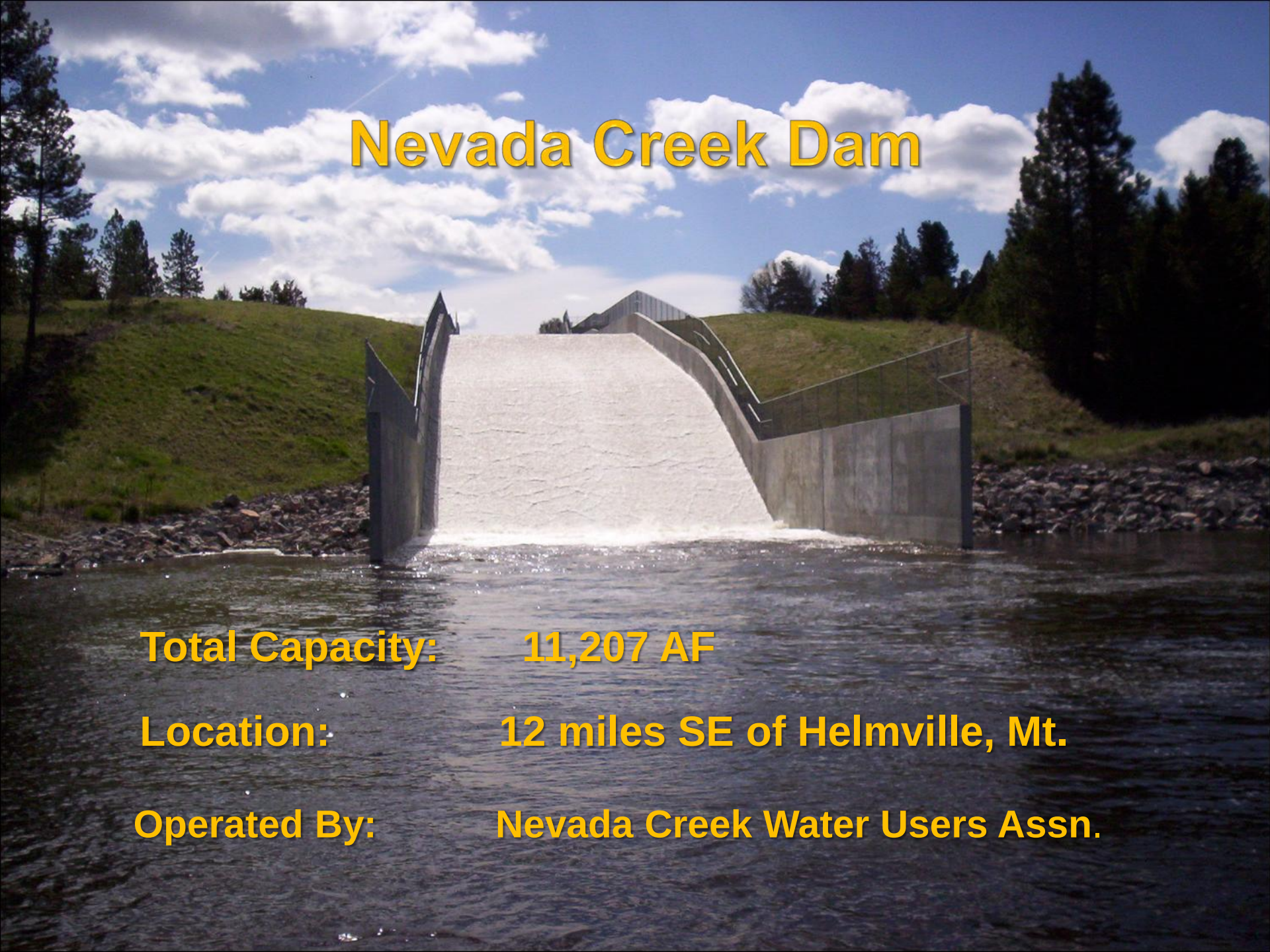


Reservoir Surface Area: 390 acres at full pool

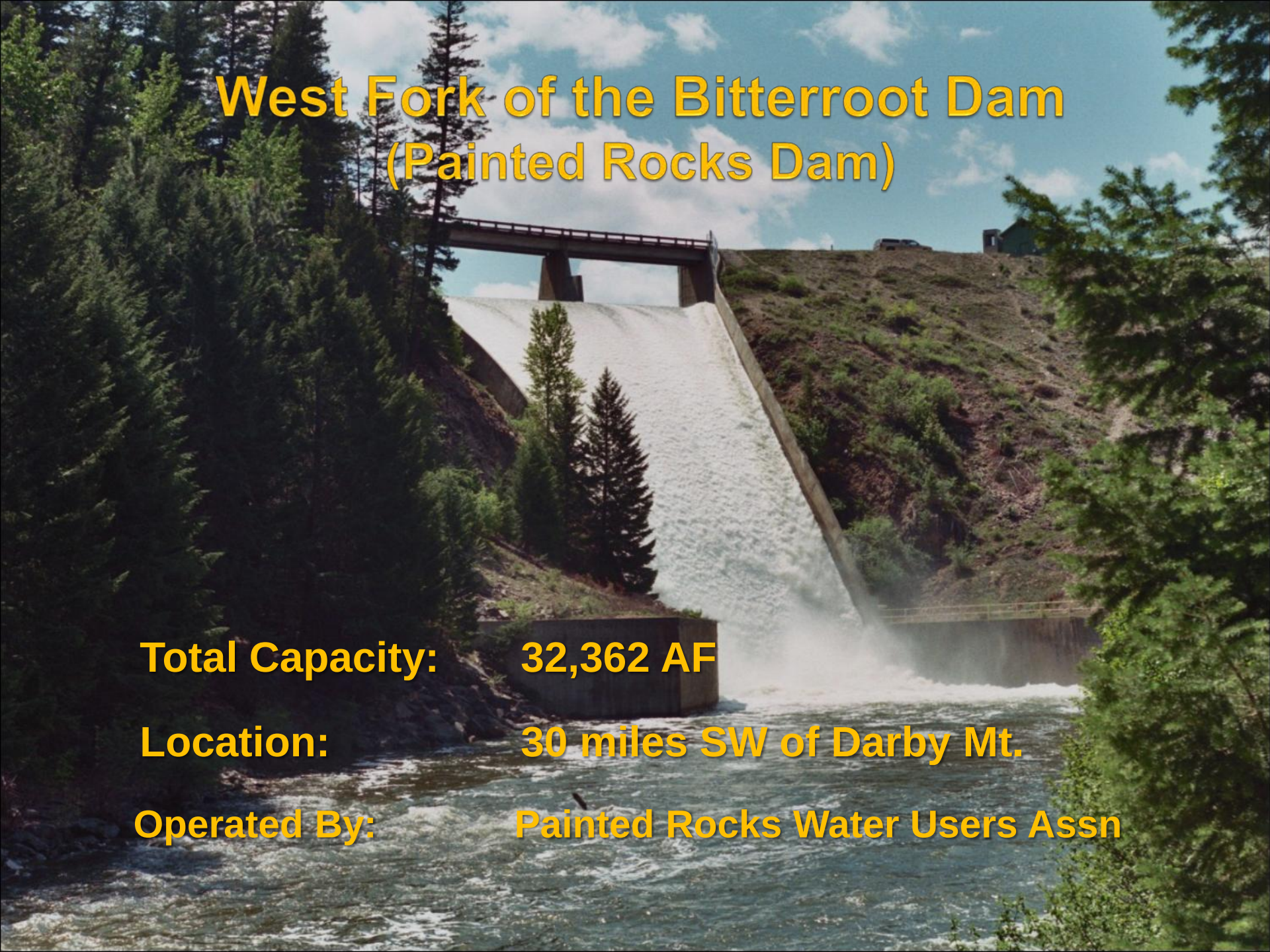
Provides supplemental irrigation water to 25,000 acres in the Flint Creek Valley.

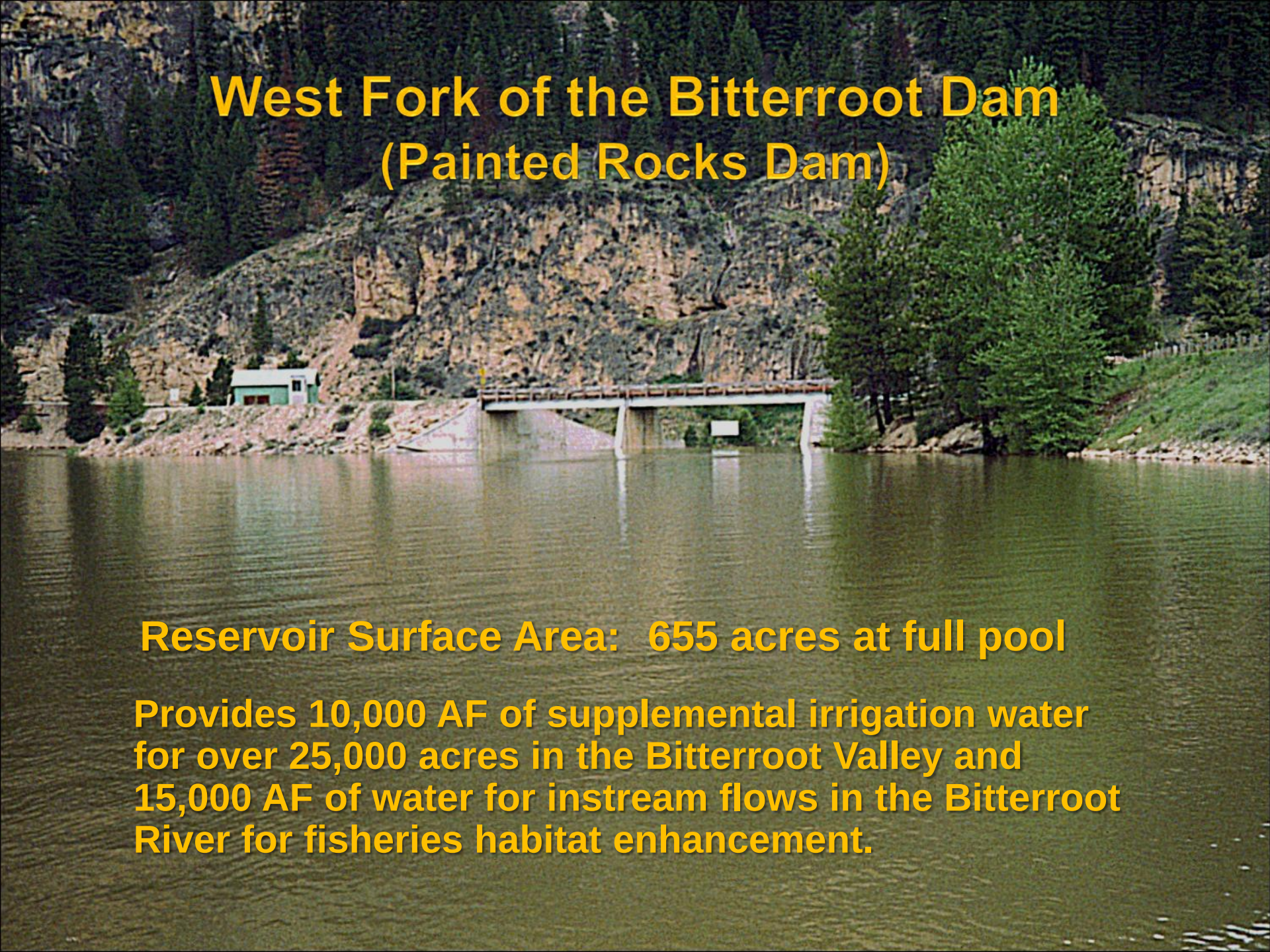

Fred Burr Dam
Total Capacity: 516 AF
Location: 10 miles NW of Hamilton Mt.
Operated By: Fred Burr Water Users Assn.
2007/07/07


Fred Burr Dam
Reservoir Surface Area: 28 acres at full pool
Supplemental irrigation water for 860 acres.


Nevada Creek Dam
Total Capacity: 11,207 AF
Location: 12 miles SE of Helmville, Mt.
Operated By: Nevada Creek Water Users Assn.


Nevada Creek Dam
Reservoir Surface Area: 368 acres at full pool
Provides full service irrigation for 1000 acres and supplemental irrigation for 10,000 acres near Helmville and Ovando Mt.


West Fork of the Bitterroot Dam
(Painted Rocks Dam)
Total Capacity: 32,362 AF
Location: 30 miles SW of Darby Mt.
Operated By: Painted Rocks Water Users Assn



West Fork of the Bitterroot Dam
(Painted Rocks Dam)

Reservoir Surface Area: 655 acres at full pool

Provides 10,000 AF of supplemental irrigation water for over 25,000 acres in the Bitterroot Valley and 15,000 AF of water for instream flows in the Bitterroot River for fisheries habitat enhancement.

DNRC State Water Projects Bureau

RESERVOIR	TOTAL CAPACITY (includes dead storage)*	CONTENTS						
	Full Pool	AVERAGE	Last Year	Last Month	PRESENT	% CAPACITY	%AVERAGE	READING DATE
	Contents	1960 - 2014	3/31/2014	2/28/2015	3/31/2015	3/31/2015	3/31/2015	
ACKLEY	6,722	3,231	4,153	3,851	3,997	59	124	3/31/2015
BAIR	7,300	4,373	3,773	5,200	5,609	77	128	3/31/2015
COONEY	28,230	20,912	21,461	20,311	22,280	79	107	4/3/2015
COTTONWOOD	1,900	1,014	1,596	1,284	1,940	102	191	3/16/2015
DEADMAN'S BASIN	75,968	49,256	56,444	65,930	70,577	93	143	3/30/2015
E.F. ROCK CREEK	16,040	9,591	9,720	10,589	11,045	69	115	3/30/2015
FRENCHMAN	2,777	2,156	2,777	2,777	2,777	100	129	3/31/2015
MARTINSDALE	23,348	9,135	7,344	17,937	19,337	83	212	3/30/2015
MIDDLE CREEK	10,184	6,163	4,499	5,418	5,818	57	94	3/30/2015
NEVADA CREEK	11,207	7,819	6,521	9,574	10,861	97	139	3/29/2015
NILAN	10,992	6,707	6,391	8,532	10,020	91	149	3/31/2015
N.FK. SMITH RIVER	11,406	7,082	8,148	9,000	10,330	91	146	3/31/2015
RUBY RIVER	37,612	31,222	34,501	34,212	37,137	99	119	3/30/2015
TONGUE RIVER	79,071	50,139	60,558	52,106	56,093	71	112	3/30/2015
W.F. BITTERROOT	32,362	9,221	14,125	13,528	20,019	62	217	3/27/2015
WILLOW CREEK	18,000	16,386	16,183	14,300	16,127	90	98	3/25/2015
YELLOWATER	3,842	1,250	3,496	3,106	3,236	84	259	3/31/2015

Summary

Due to good carry over storage from this past fall the reservoir levels were generally higher going into this past winter.

March rains melted a lot of the low level snow pack earlier than normal which hindered storage in reservoirs that still had ice cover.

While the snowpack is currently lower than average, all of the SWP reservoirs are being managed to fill and operate on a normal basis.

Climate 2015: When it rains, it stores!

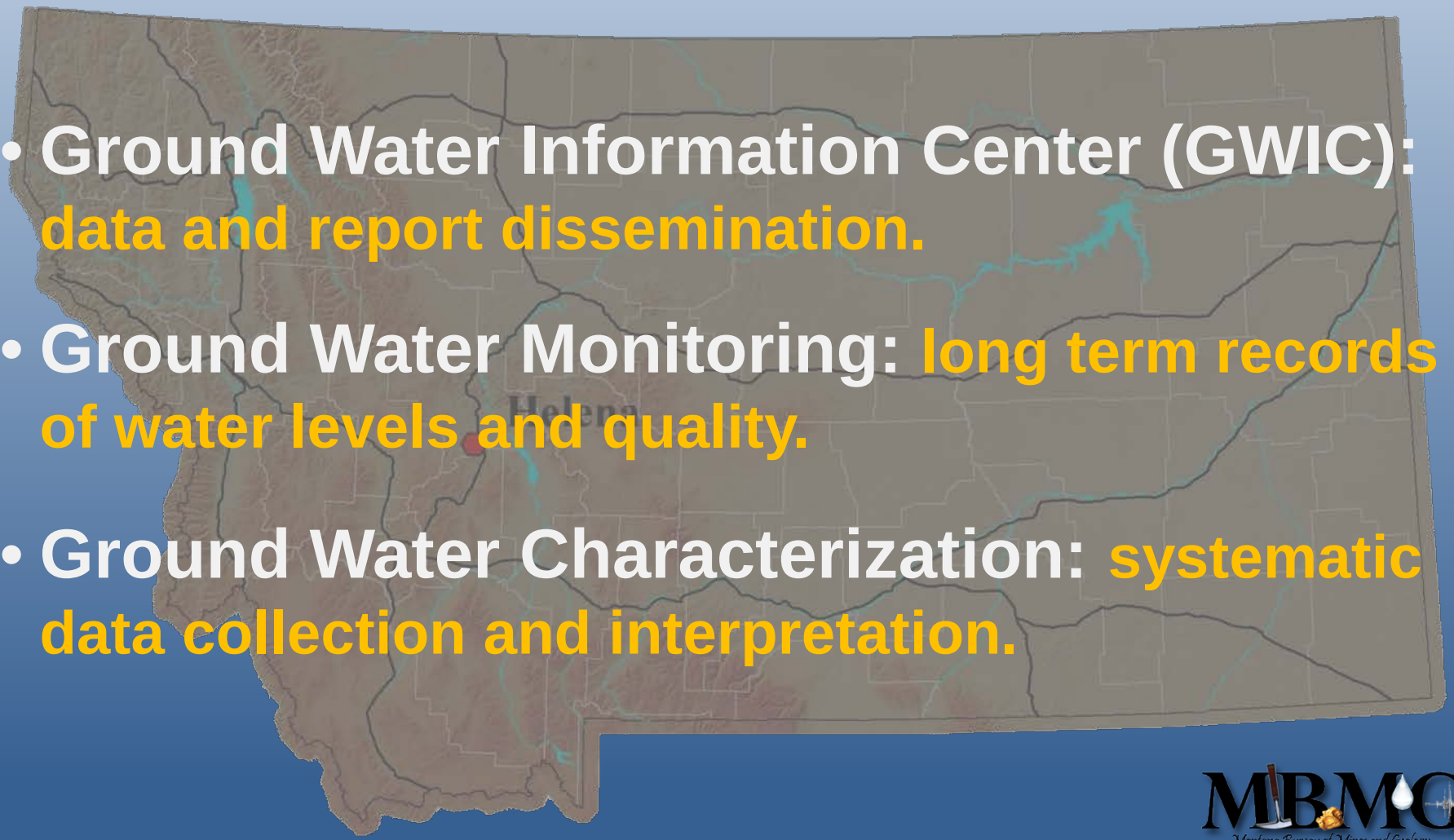
Clark Fork / Kootenai River Basins:
2015 Water-use seasonal outlook

Thomas Patton
April 23, 2015

MBMG
Montana Bureau of Mines and Geology

Brought to you by:

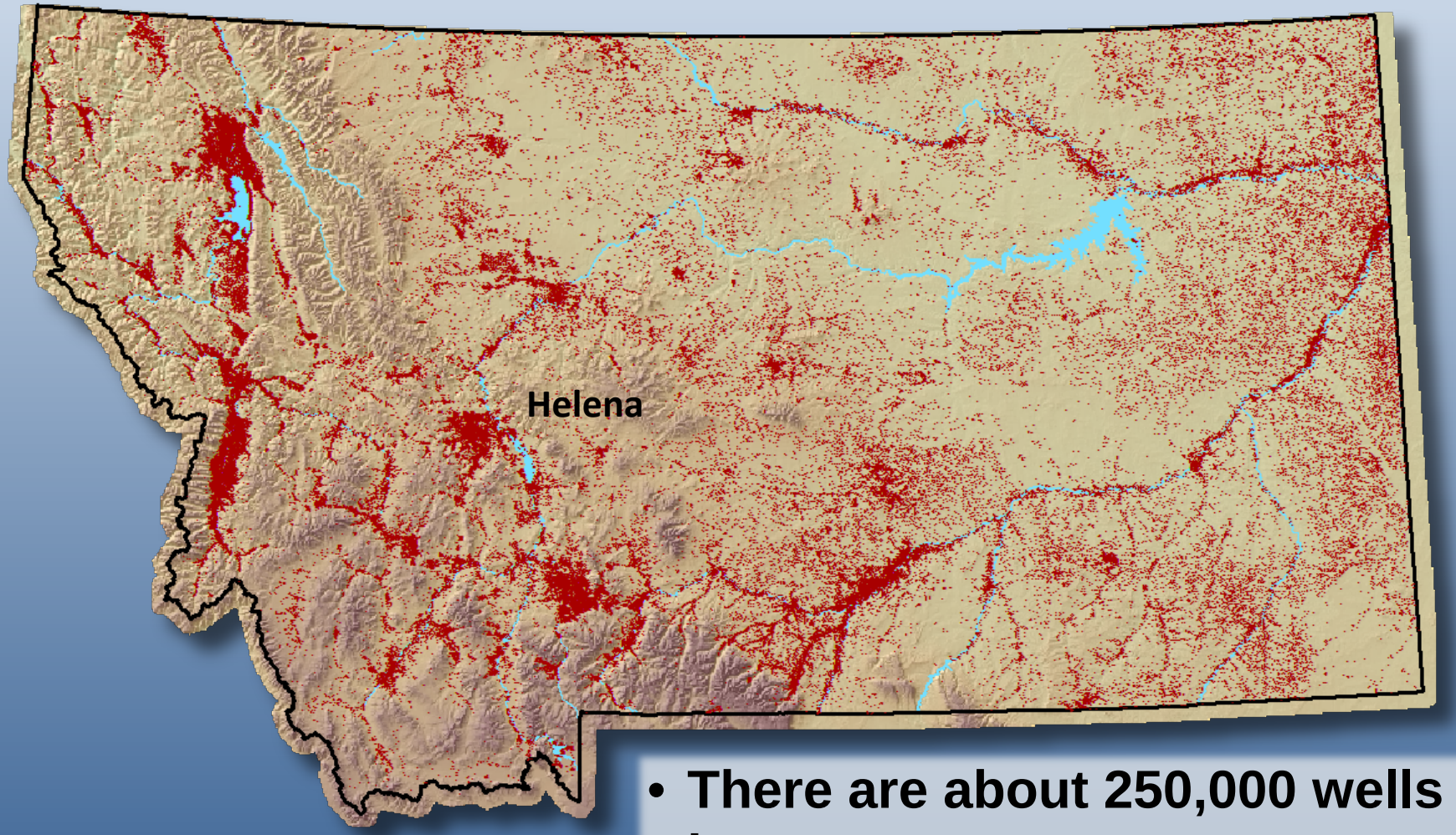
Montana Ground Water Assessment



- Ground Water Information Center (GWIC): data and report dissemination.
- Ground Water Monitoring: long term records of water levels and quality.
- Ground Water Characterization: systematic data collection and interpretation.

MBMG
Montana Bureau of Mines and Geology

Wells in Montana

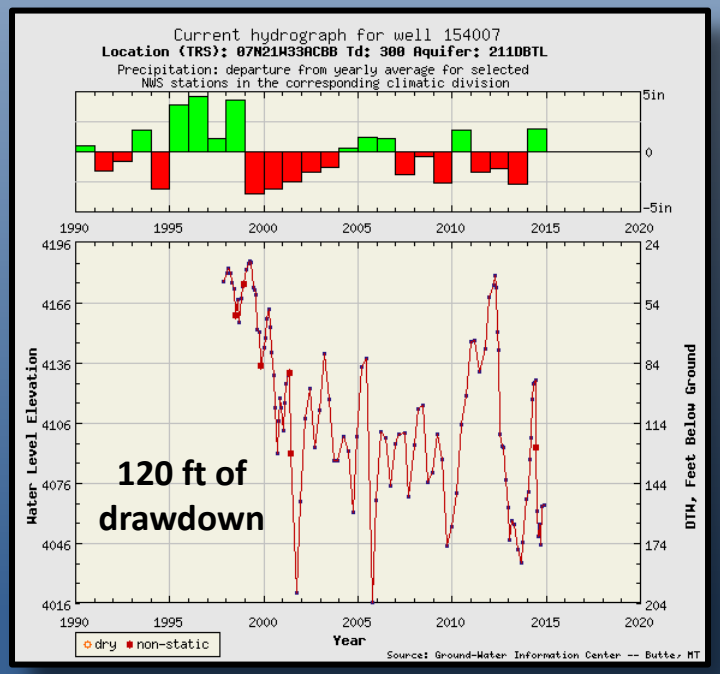


- There are about 250,000 wells in Montana.

- How can we use data from wells to understand how aquifers react to variable climate?

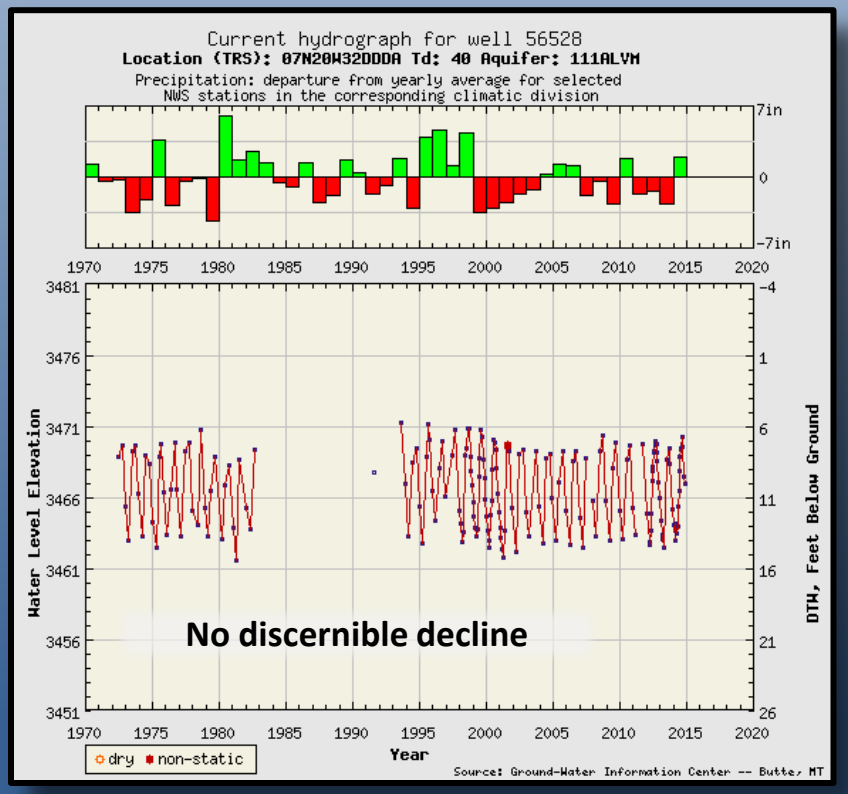
Wells are like people, they (we) all react differently to stress

- **Large drawdown relative to available water column.**
  - **Completed 1995 – domestic well serving in Ravalli County**
  - **TD: 174, airlifted at 8 gpm for 1 hr with drill steel set at 160 ft.**
  - **Water levels fell 90 ft in response to climate between 1998 and 2004.**

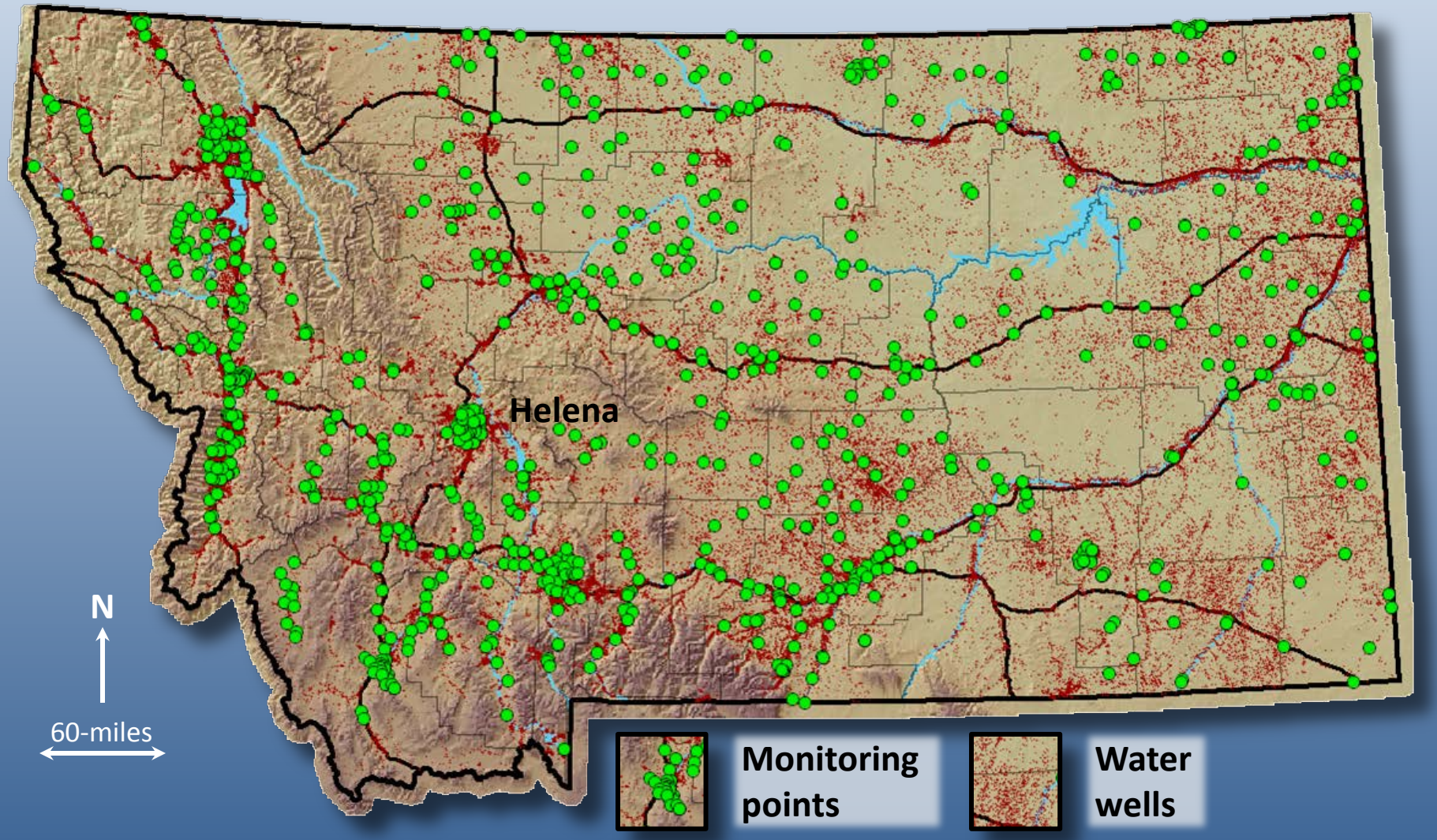


Wells are like people, they (we) all react differently to stress

- **Little drawdown relative to available water column.**
  - **Domestic well serving in Ravalli County**
  - **TD: 40, airlifted at 20 gpm for 1.5 hr with drill steel set at 20 ft.**

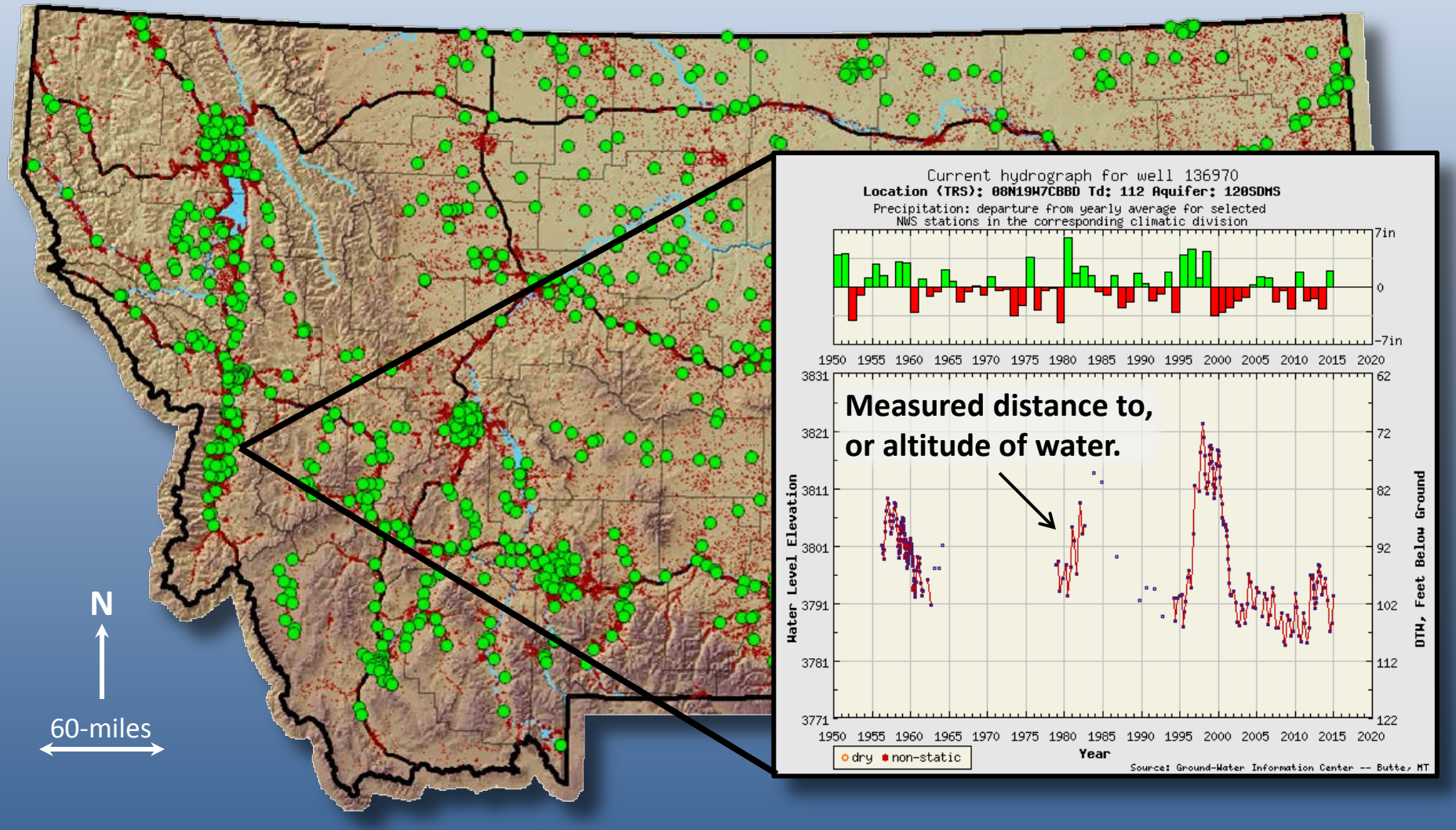


Groundwater monitoring



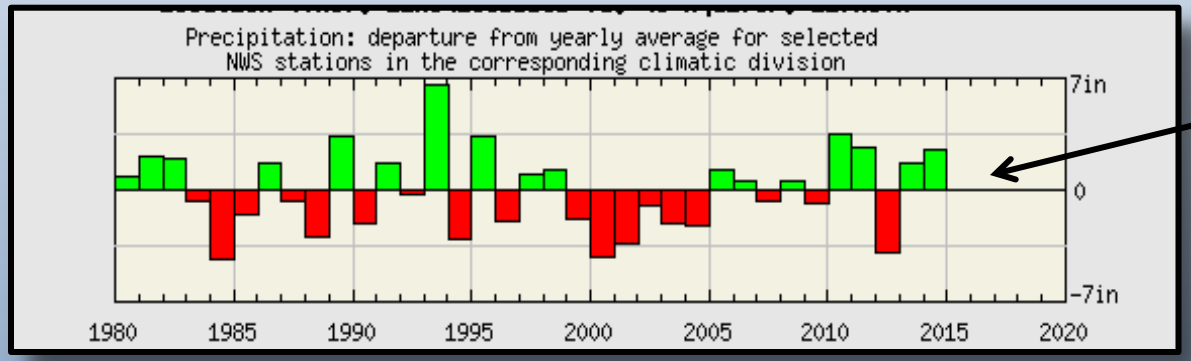
1,008 monitoring wells. About 30 percent (300+/-) dedicated or unused wells, 106 instrumented wells.

Groundwater monitoring



- **The data are used to track water-level change.**

Thinking about water balance



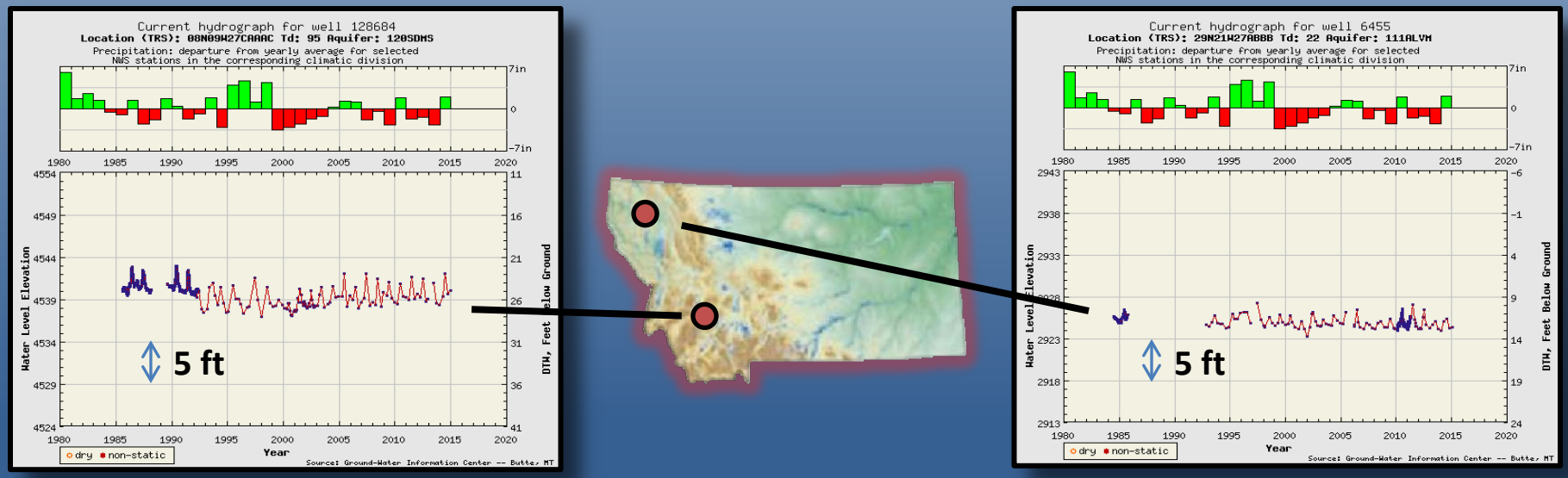
Precipitation varies about an average or normal.

Water levels in aquifers rise when more water enters than leaves, and drop when more water leaves than enters.

Water levels also vary about an average or normal.

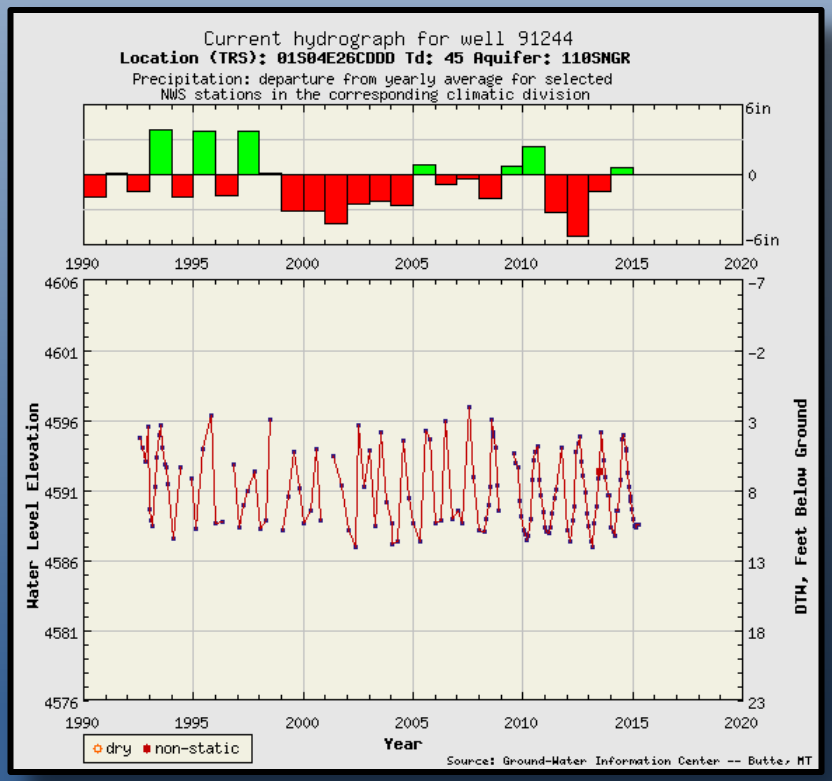
Weather or climate?

- Recharge from a single storm may be observable on a hydrograph, but by itself may not change a long-term water-level trend.
- Similarly, a flooding rain during a drought may not eliminate a long-term precipitation shortfall.
- Long-term recharge is comparable to the accumulation of individual weather events into climate. If there are enough events to provide more water for aquifer recharge than is discharged, water levels will rise.

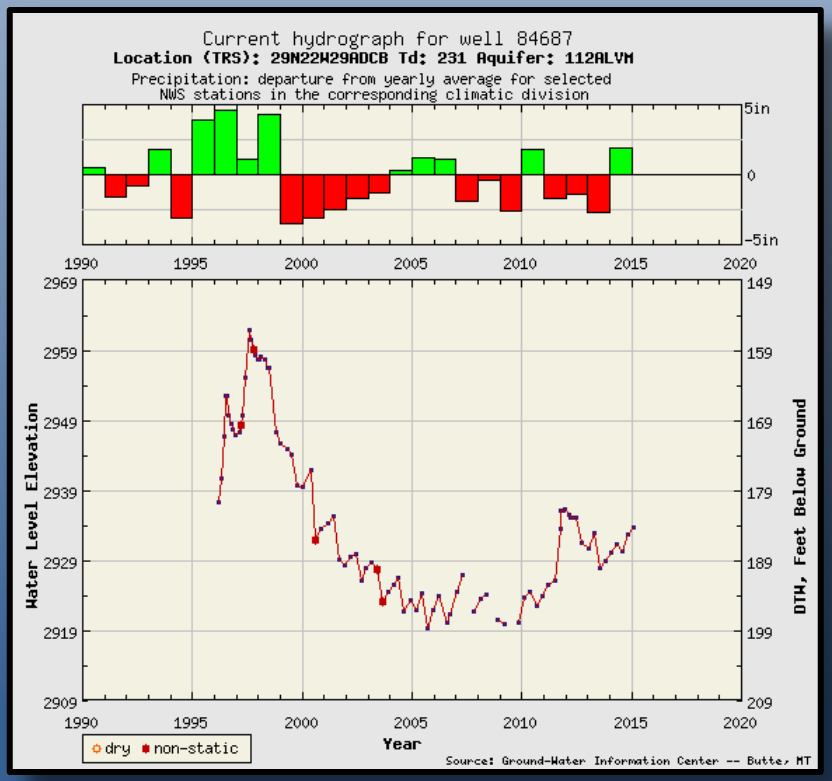


Climate sensitive wells

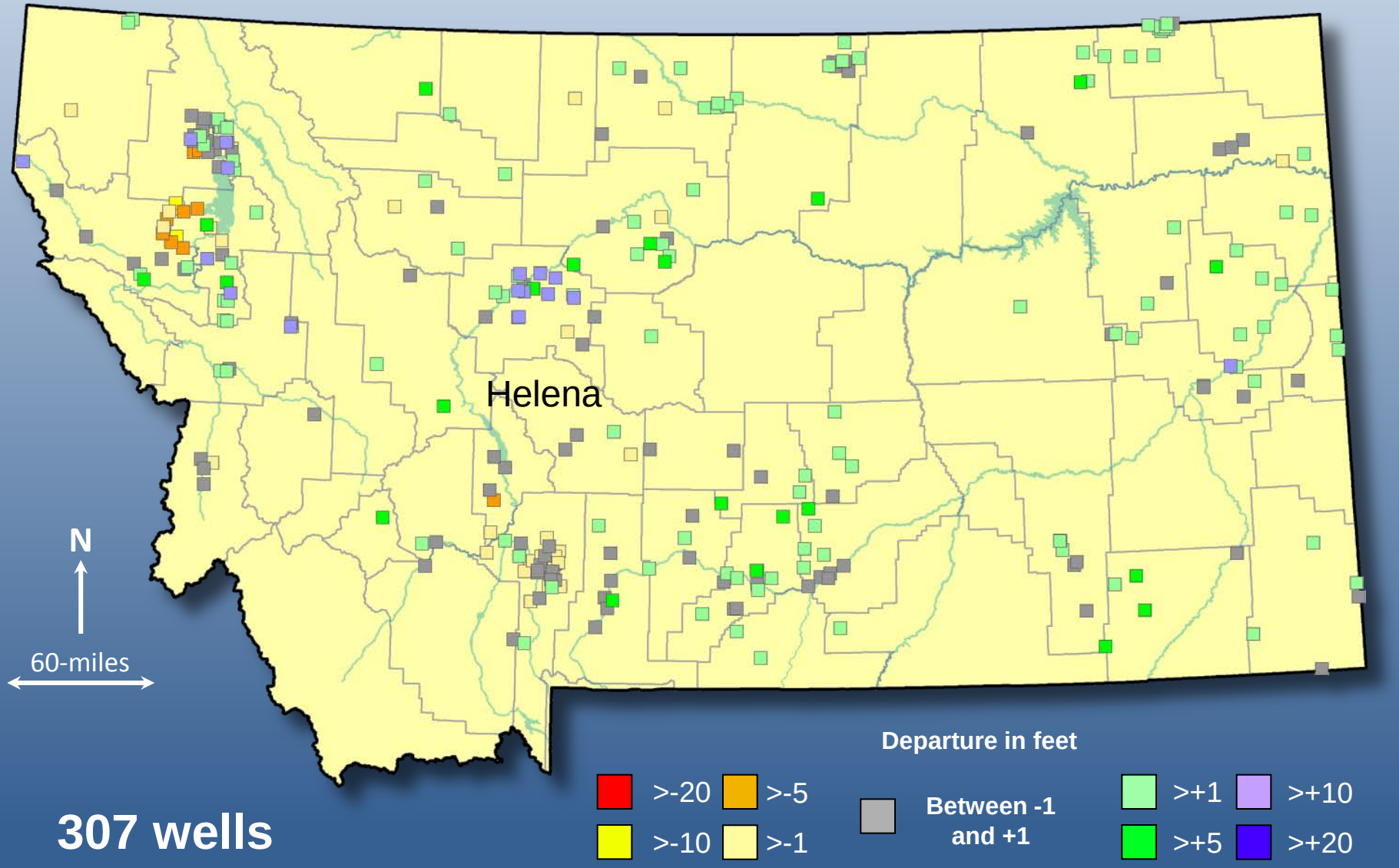
Hydrographs with little to no low-frequency signal (~440 wells)



Hydrographs with a low-frequency signal (~550 wells)

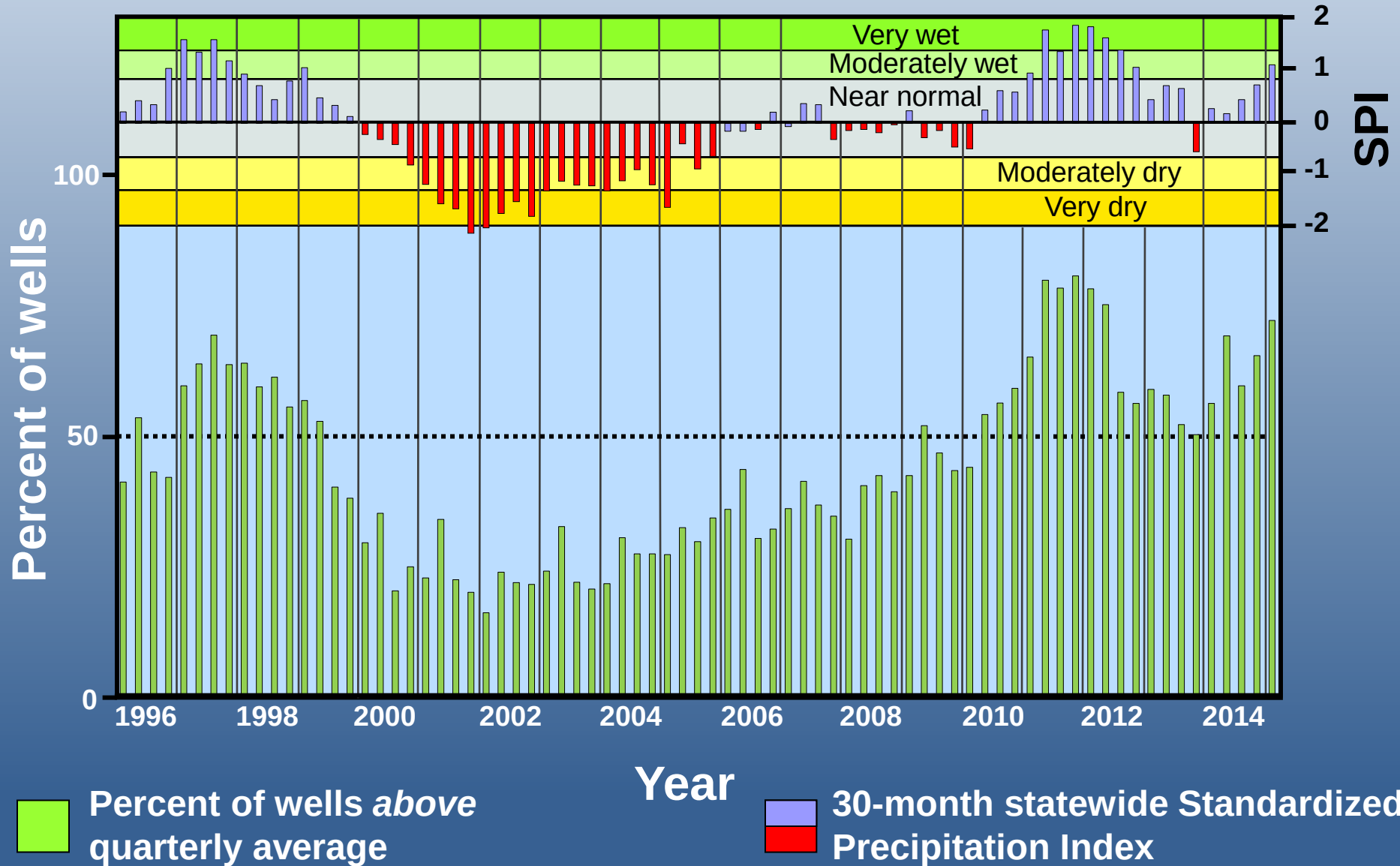


January – March 2015: groundwater-level departures from average



307 wells

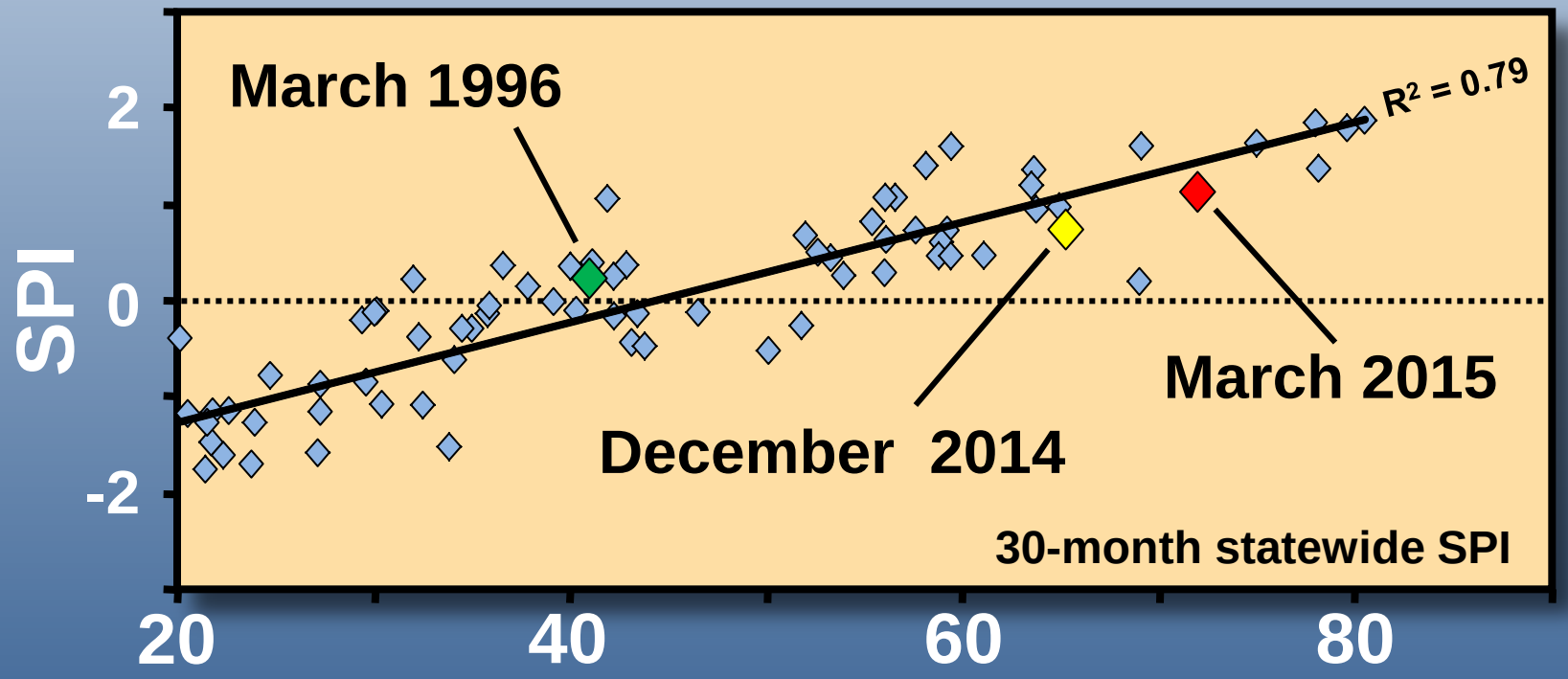
Departures from quarterly average water level: climate-sensitive wells



Percent of wells *above* quarterly average

30-month statewide Standardized Precipitation Index

Statewide monitoring network: Percentage of climate-sensitive wells above average and SPI: 1996-2015

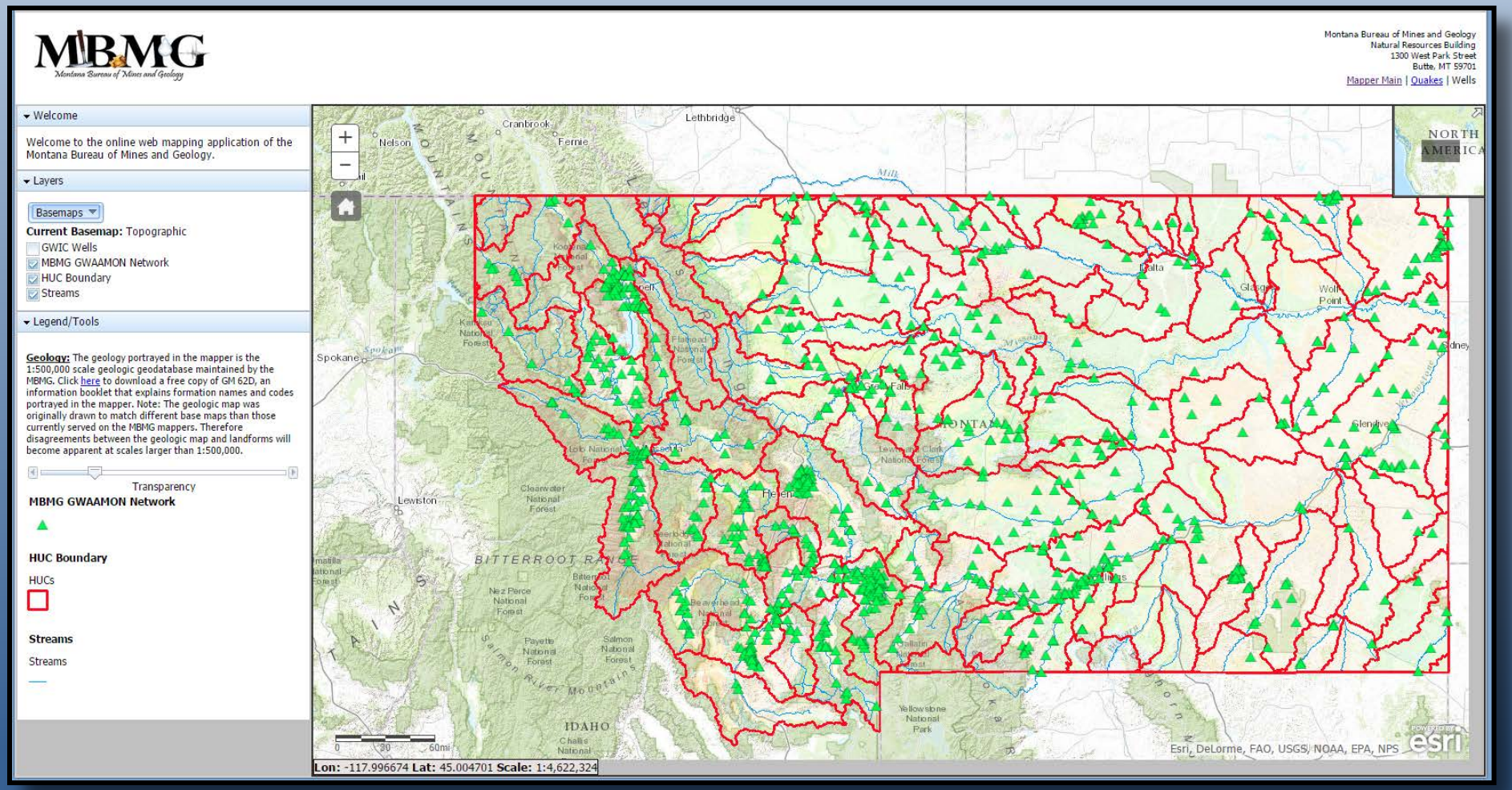


Summary

- **Water levels rise or fall depending on how wet or dry it has been for the preceding 30+/- months.**
- **Groundwater levels rose statewide during 2011-2012. In June 2011 the 30-month statewide SPI was the wettest it had been in the last 60 years.**
- **Since 2012 the statewide SPI has approached, but remained on the wet side of normal. The number of wells with above average water-levels has been between 60 and 70 percent.**

MBMG mapper

http://data.mbmg.mtech.edu/mapper/mapper.asp



Ground Water Information Center

File Edit View Favorites Tools Help

Convert Select

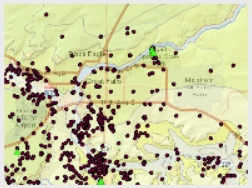
Groundwater Information Center
Montana Bureau of Mines and Geology
Montana Tech of The University of Montana
1300 West Park Street - Natural Resources Building Room 329
Butte Montana 59701-8997
Ph: (406) 496-4336 Fx: (406) 496-4343

4/3/2013

| Home | Well Data | Reports | DrillerWeb | DNRC | Help! |

Mapper Release March 1, 2013

The Montana Bureau of Mines and Geology has released its online web mapping application. Click the image to the right to start using the mapper. Currently displayed are statewide monitoring network wells, GWIC wells and 1:500K geologic maps.



Sign In Status: Signed Out

Enter your User Id and Proposed Data Use. Click **Sign In** to access GWIC's online services.

If you do not have a User Id, click create one here.

User Id:
Data Use: Pick One
Sign In

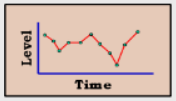
Drought Reports more reports

Download an Adobe Acro... discusses how aquifers respond to climatic cond... statistics about how well... network are responding ...

Coalbed Methane GW Monitoring Network

...iver Regional ...oring network of ...m plus site ...hane infiltration ...downloaded ... coalbed methane project data.

Statewide Monitoring Network



GWIC features current hydrographs for wells that are being measured regularly by MBMG and its cooperators. Click the picture to to the left to view data collected by the Statewide Monitoring Program. Data from other MBMG projects are available through the SWL Menu after you sign in.

View a list of statewide monitoring network wells. The listing is by number of wells per county.

A little about us

The Ground-Water Information Center (GWIC) at the Montana Bureau of Mines and Geology (MBMG) is the central repository for information on the ground-water resources of Montana. The data include well-completion reports from drillers, measurements of well performance and water quality based on site visits, water-level measurements at various wells for periods of up to 60 years, and water-quality reports for thousands of samples. The databases at GWIC are continually updated with new data from driller's logs, MBMG research projects, and research projects from other agencies.

County-wide Statistics more reports

View statistical overviews of the well

Other sites of interest

- DNRC - Department of Natural Resources and Conservation
- NRIS - Natural Resource Information System (Montana State Library)

100%

http://mbmggwic.mtech.edu

Climate 2015: When it rains, it stores!

Clark Fork / Kootenai River Basins:
2015 Water-use seasonal outlook

MONTANA CLIMATE OFFICE

Update – April 2015

State Climatologist
Dr. Kelsey Jencso
Assistant Professor, Watershed Hydrologist

Assistant State Climatologist
Dr. Ashley Ballantyne
Assistant Professor, Bioclimatology

Climate Science
[Dr.] Jared Oyler
Ecological Climatologist and
Software Engineer

Research Scientist
Dr. Nick Silverman
Hydroclimatologist

Research and Information Services
Michael Sweet
Information Technologies and GIS
MSDI Steward for Climate

http://climate.umt.edu/

COLLEGE OF FORESTRY & CONSERVATION
UNIVERSITY OF MONTANA

The Montana Climate Office is the official steward of climate information for Montana

June 2013: The Montana Land Information Advisory Council (MCA 90-1-404) accepted Climate as Montana's 15th statewide spatial data theme and forwarded that recommendation onto the State Library Commission.

August 2013: The State Library Commission (MCA 90-1-413) approved Climate as an official Montana Spatial Data Infrastructure (MSDI) layer and identified the Montana Climate Office as the official state steward

First state in the nation to make this designation!

> *"A Montana Framework Data Layer is a State recognized, commonly needed and digitally formatted representation of land information features, natural and cultural that are coordinated, developed, integrated, maintained, and distributed through a community based effort over the geographic area of Montana and are, in the determination of the Montana Land Information Advisory Council and the Geographic Information Officer, significant to a broad variety of users within Montana and the Nation."*

http://geoinfo.msl.mt.gov/Home/msdi

Current distribution of datasets

- Observations from climate stations
- Gridded precipitation
- Gridded temperature (min, mean, max)
- Normalized Difference Vegetation Index (NDVI)
- Enhanced Vegetation Index (EVI)
- Evapotranspiration (ET)
- Potential evapotranspiration (PET)
- Drought Severity Index (DSI)
- Source datasets for all of the above and additional Montana Climate Office resources

Distribution protocols

- Distributed in Montana State Plane NAD83 for ease of integration
- Published ISO metadata with the Montana State Library's data list
- Available in both an open-source and Esri geodatabase format
- A thematic GeoTIFF is provided as a browse graphic
- Updates occur on either a daily, weekly, monthly, or yearly schedule depending on the source data
- Source dataset is available for all published products

The quest for regionalized or localized application of global climate models is driving near-term research efforts (next 2-3 years):

In Progress

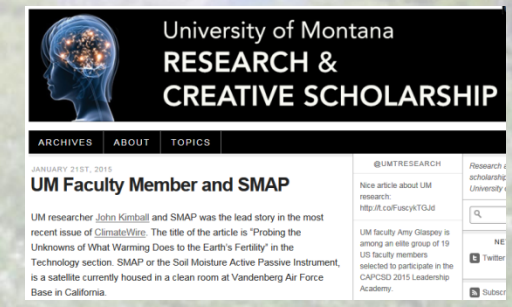
- Develop improved historic gridded temperature model (national)
- Develop improved historic gridded dew point model (national)
- Develop improved historic gridded precipitation model (regional, perhaps national)
- Develop improved evapotranspiration (MODIS MOD16) product (regional)
- Deployment of sensor packages to improve localization

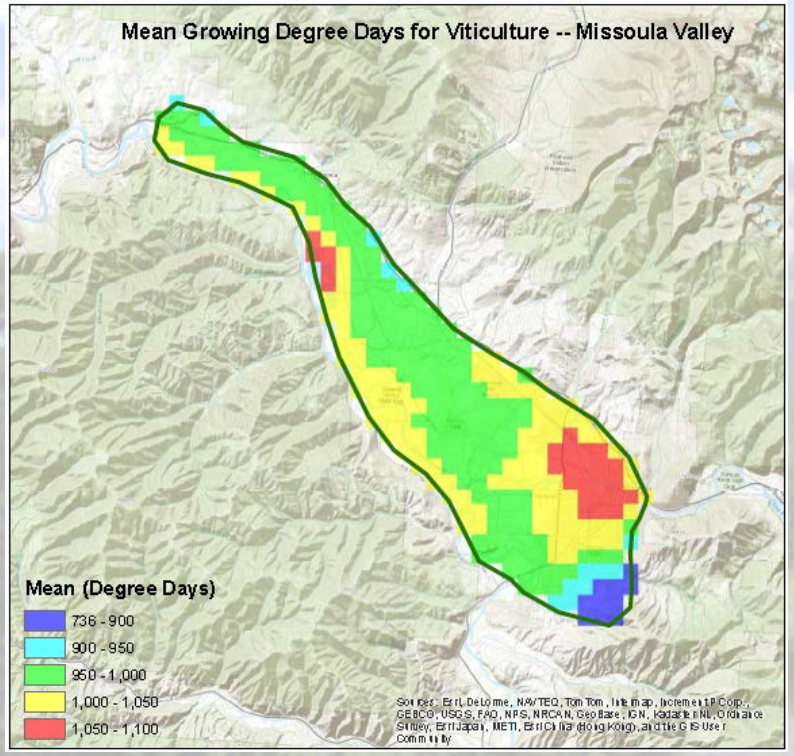
2015 and first-half of 2016

- Evaluate the influence of snowpack on interpretations
- Evaluate available climate projection datasets for their spatial and temporal viability in application to Montana's hydrologic basins
- Conduct trend analyses of climate products

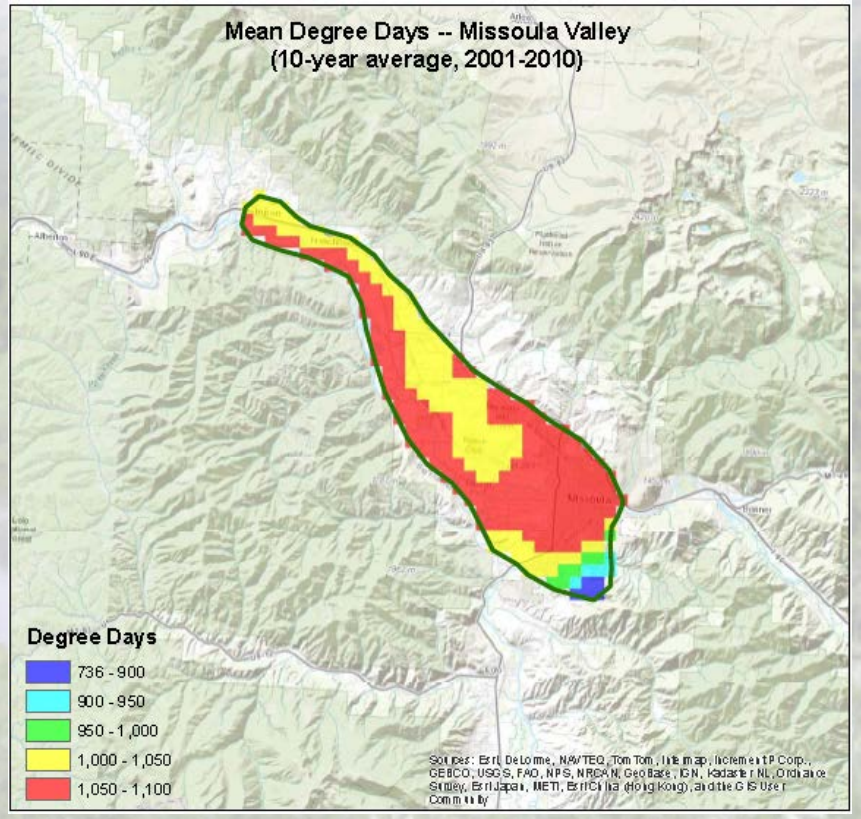
2016

- Incorporation of soil moisture from SMAP
- Integrate ground sensors with regional climate models (validation)

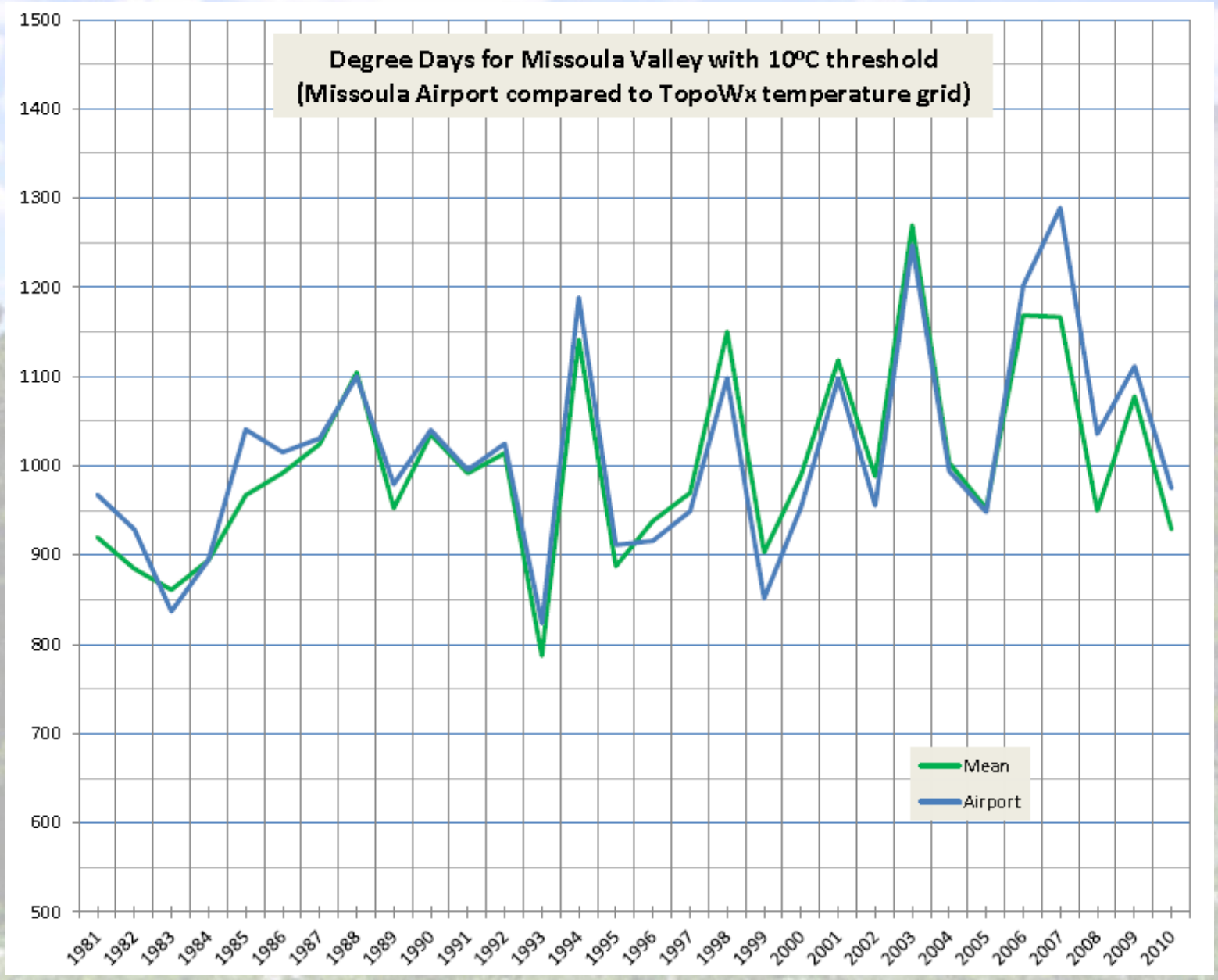




30-year normal



10-year mean


Degree Days for Missoula Valley with 10°C threshold
(Missoula Airport compared to TopoWx temperature grid)
1500
1400
1300
1200
1100
1000
900
800
700
600
500
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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2002
2003
2004
2005
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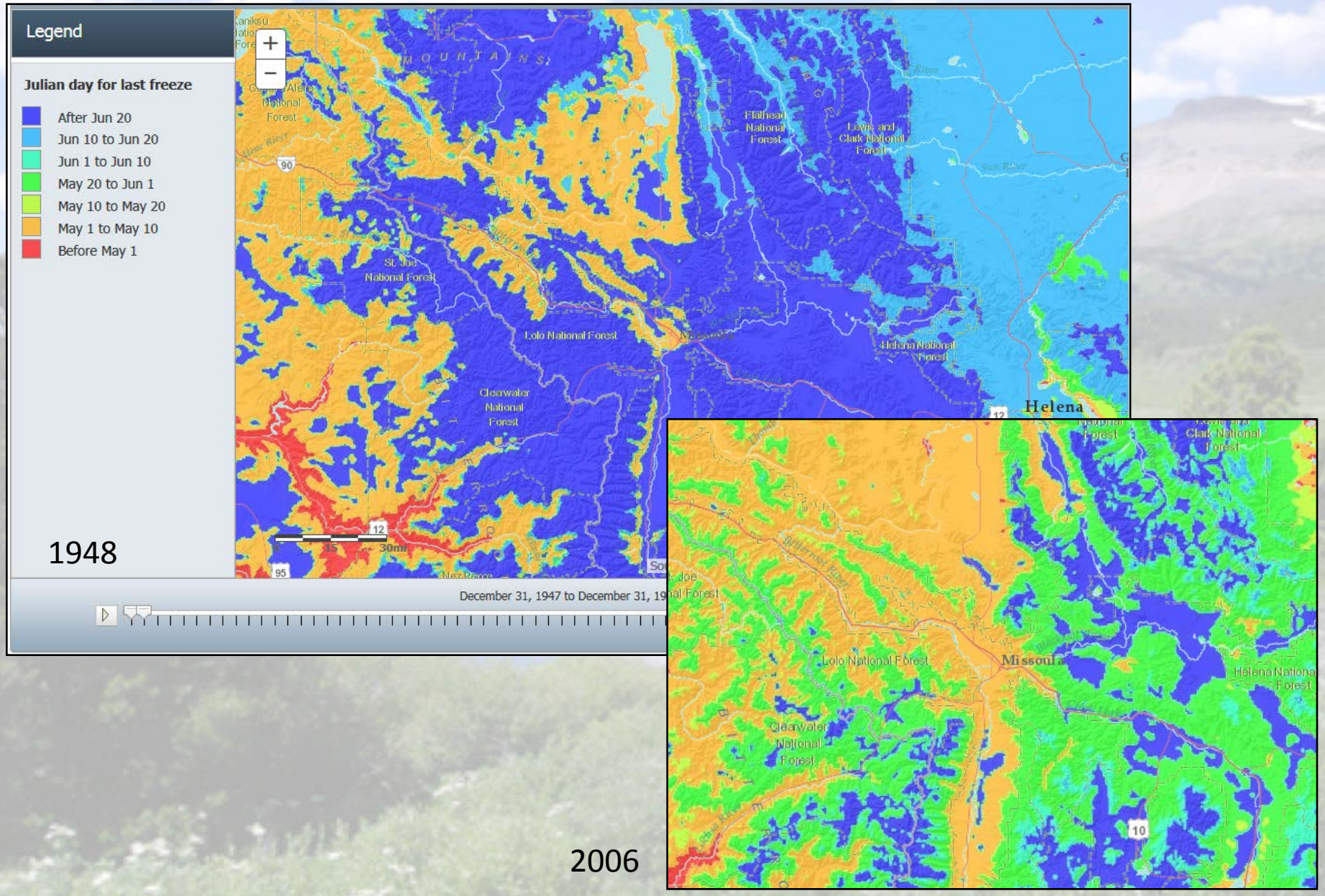
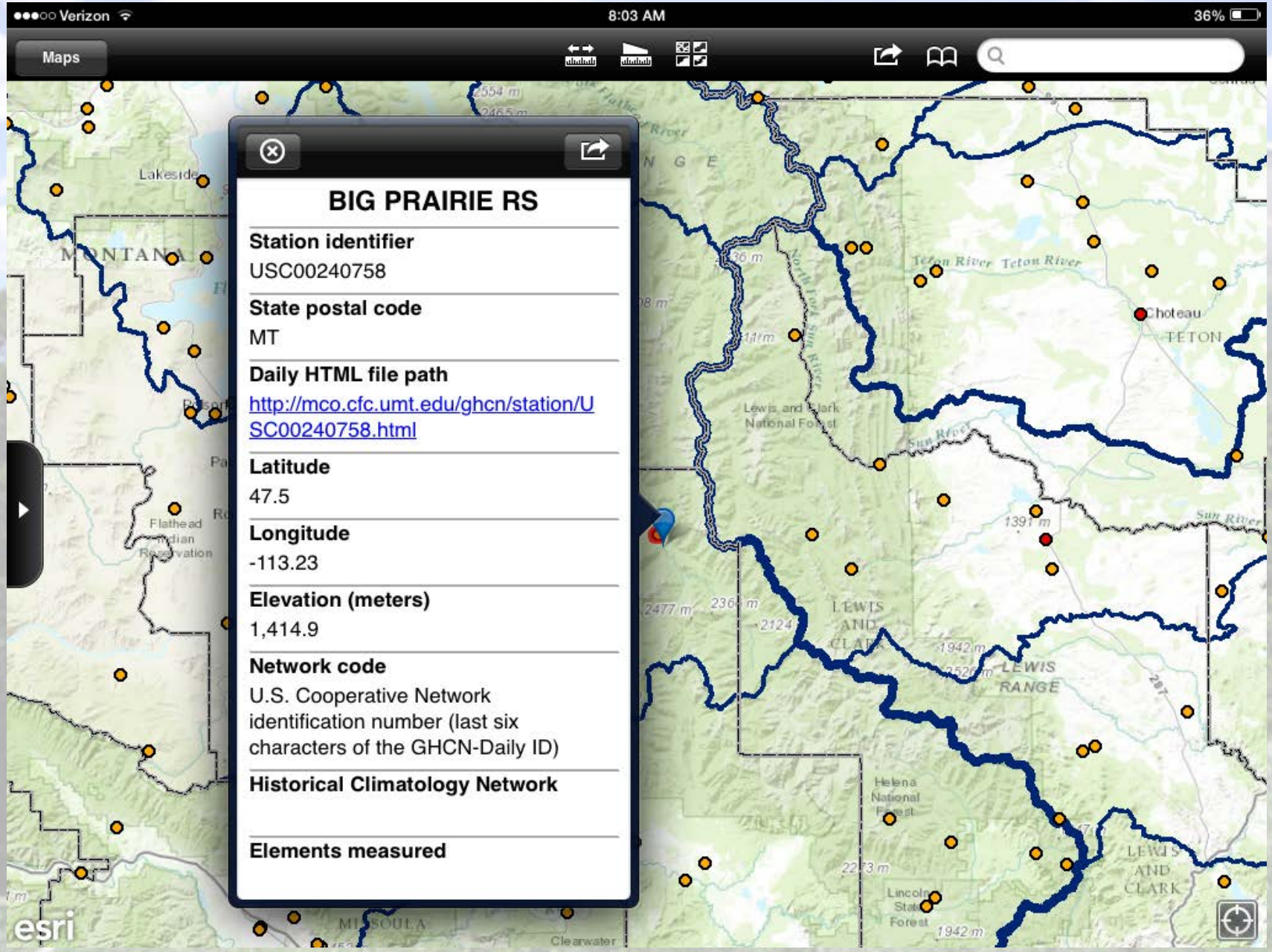
2007
2008
2009
2010
Mean
Airport


Legend
Julian day for last freeze
After Jun 20
Jun 10 to Jun 20
Jun 1 to Jun 10
May 20 to Jun 1
May 10 to May 20
May 1 to May 10
Before May 1
1948
December 31, 1947 to December 31, 19
Flathead National Forest
Lewis and Clark National Forest
St Joe National Forest
Lolo National Forest
Helena National Forest
Clearwater National Forest
Helena
Missoula
2006


Verizon
8:03 AM
36%
Maps
BIG PRAIRIE RS
Station identifier
USC00240758
State postal code
MT
Daily HTML file path
http://mco.cfc.umt.edu/ghcn/station/USC00240758.html
Latitude
47.5
Longitude
-113.23
Elevation (meters)
1,414.9
Network code
U.S. Cooperative Network identification number (last six characters of the GHCN-Daily ID)
Historical Climatology Network
Elements measured
Lakeside
MONTANA
Choteau
TETON
Lewis and Clark National Forest
Flathead Indian Reservation
LEWIS AND CLARK
LEWIS RANGE
Helena National Forest
Lincoln State Forest
MISSOULA
Clearwater
esri

Montana Climate Office

(download measurement data for this station in CSV format)

Station Details (view location map in new window)	
Station Name:	BIG PRAIRIE RS, MT USA
Station ID:	USC00240758
Lat/Long:[2]	47.5°,-113.2333°
Elevation:	4,642 feet; 1414.9 meters
Network:	C:U.S. Cooperative Network identification number (last six characters of the GHCN-Daily ID)

Element	Start	End	Years	Observations	Coverage[3]
PRCP:Precipitation (tenths of mm)	1915-6-12	1915-10-31	0	69	48%
SNOW:Snowfall (mm)	1914-8-1	1915-9-30	1	61	14%
WT16:Weather Type rain (may include freezing rain or drizzle or freezing drizzle)	1915-6-3	1915-10-25	0	29	20%

Additional information for this site is available at the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC)

[1] Dates are in standard ISO format (yyyy-mm-dd)

[2] Coordinates are in the World Geodetic Coordinate System 1984

[3] Coverage is an approximation of total completeness and the overall data range expressed as a percentage.

Provided by the Montana Climate Office, Montana University System, College of Forestry and Conservation, University of Montana, 32 Campus Drive, Missoula, MT 59812-5076, Phone: , Email: state.climatologist@umontana.edu

●●●○○ Verizon 8:04 AM 35%

ftp://mco.cfc.umt.edu/ghcnd/daily/csv/USC00240758_daily.csv

Station	Year	Month	Day	Date	Element	Value	MFlag	QFlag	SFlag
USC00240758	1914	08	01	08/01/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	02	08/02/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	03	08/03/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	04	08/04/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	05	08/05/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	06	08/06/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	07	08/07/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	08	08/08/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	09	08/09/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	10	08/10/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	11	08/11/1914 0:00:00	SNOW	0			6
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USC00240758	1914	08	16	08/16/1914 0:00:00	SNOW	0			6
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USC00240758	1914	08	20	08/20/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	21	08/21/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	22	08/22/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	23	08/23/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	24	08/24/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	25	08/25/1914 0:00:00	SNOW	0			6
USC00240758	1914	08	26	08/26/1914 0:00:00	SNOW	0			6

Clark Fork River Basin

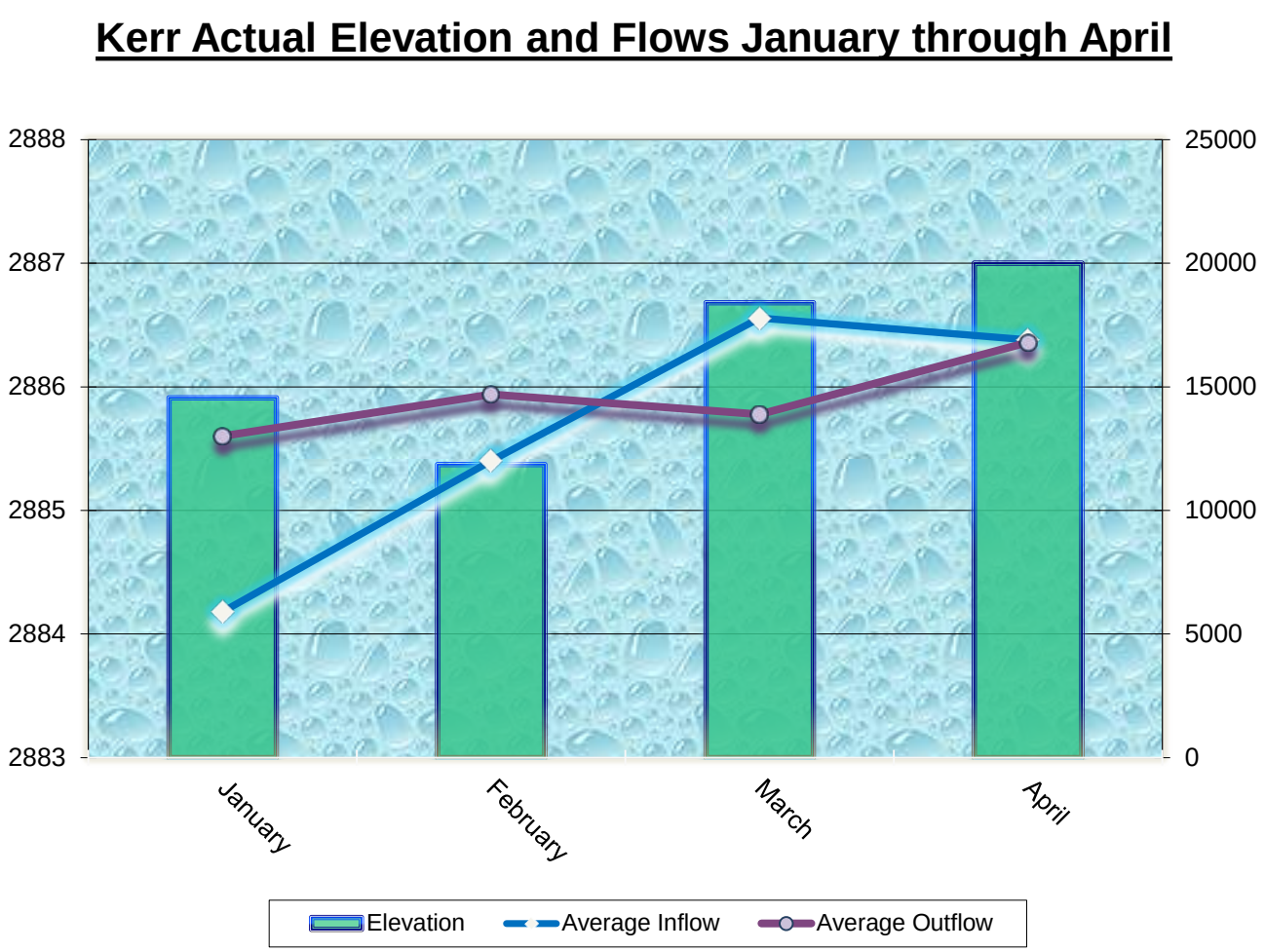
Water Year Spring 2015 Outlook

April 23, 2015

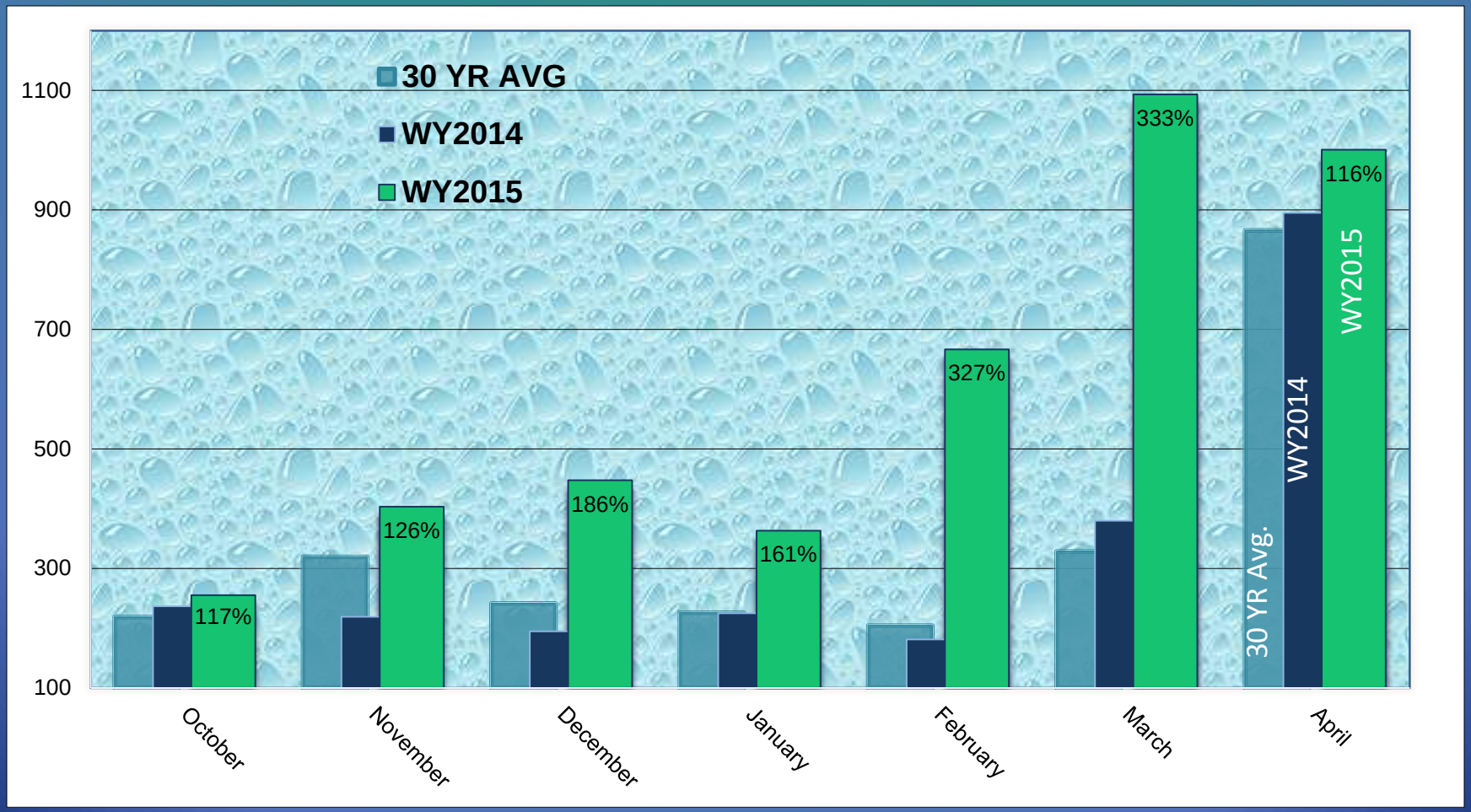
Kerr Dam Operations

Deb Mullowney, Resource Coordinator
406~497~3509
Deb.Mullowney@northwestern.com

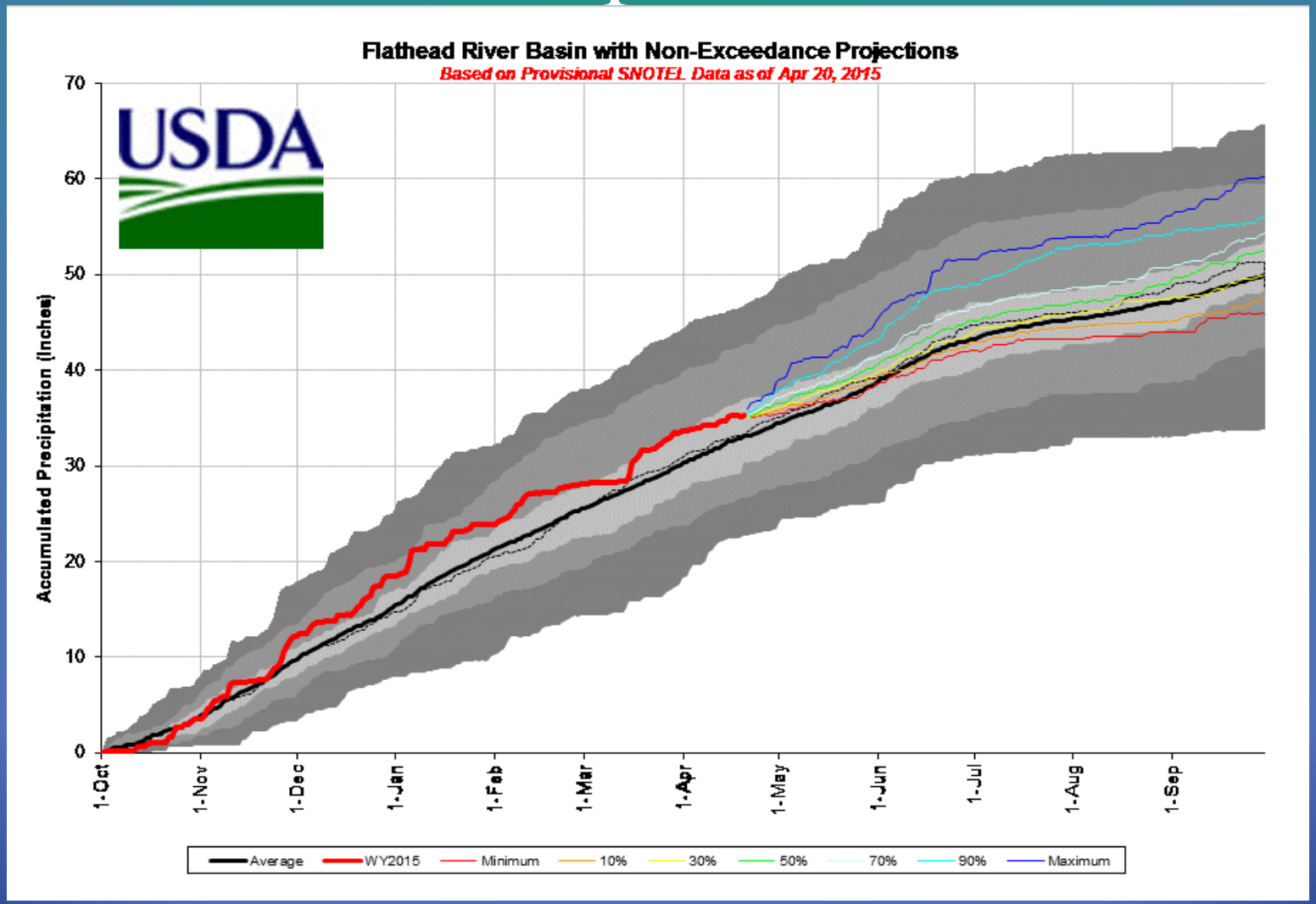
2015 Operations To Date



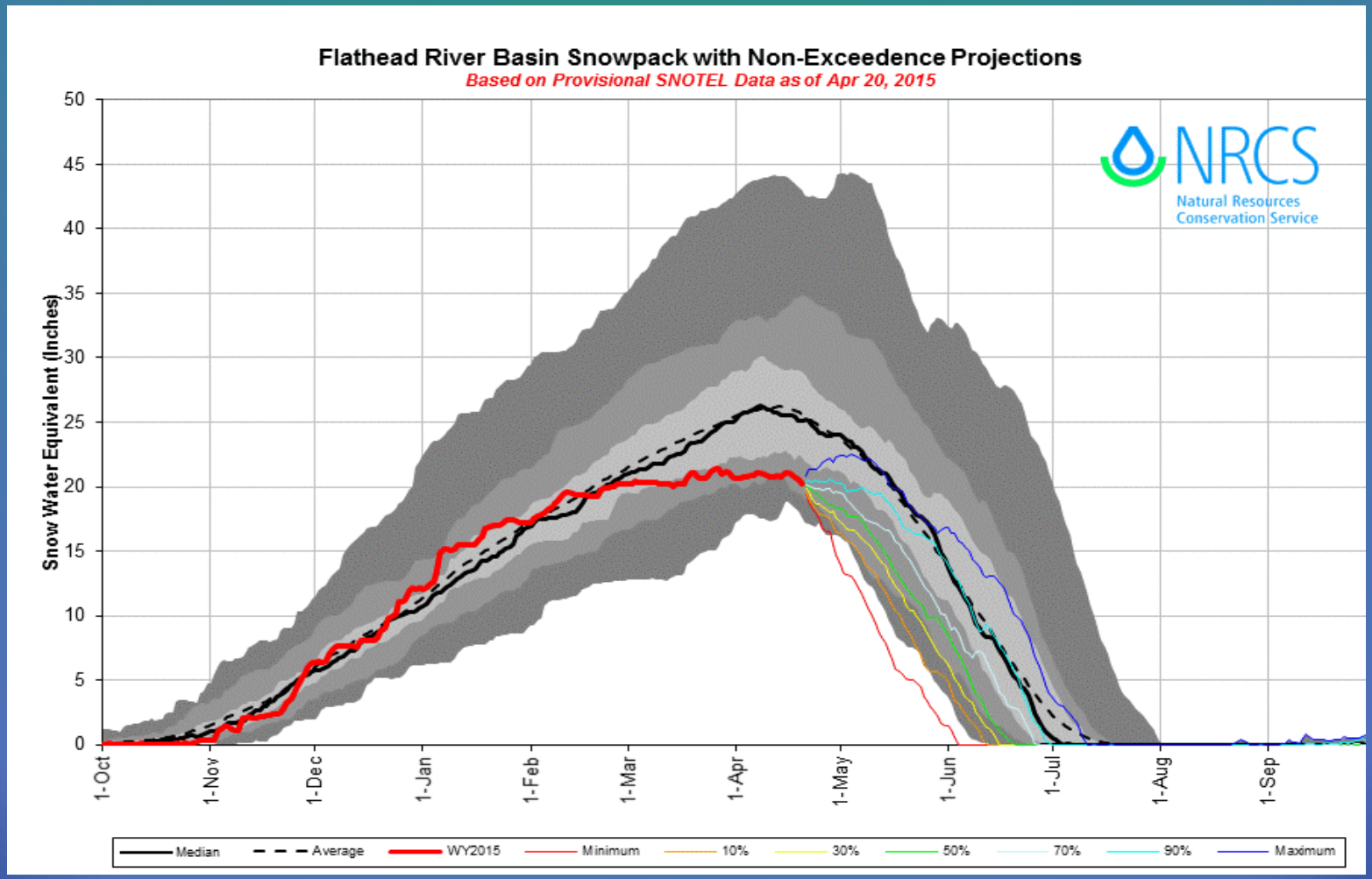
Natural Flow in KAF
for WY 2015, 2014 and 30 Year Average



Precipitation



Snow Water Equivalent

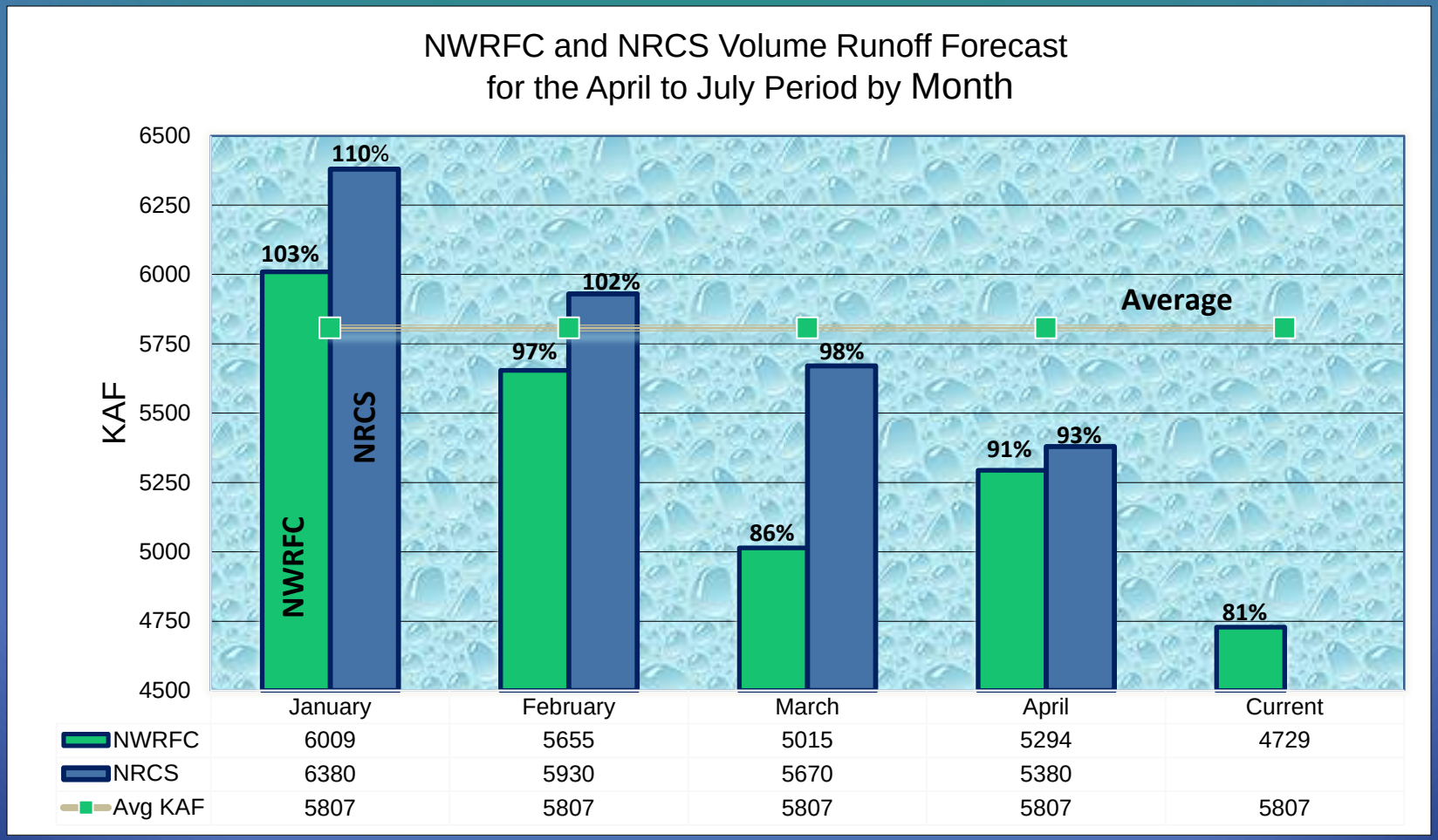


Side note: Flathead Basin SWE is currently 223” versus 427” in 2014.

Current Status Summary

- Flathead River Basin Snowpack ~ 82%
- Inflow~ 17k average to date
- Outflow~ 17k average to date
- Elevation~ 2886.97 ft
- Elevation target of 2890.0ft by Memorial Day
- Full Pool of 2893.0 ft by June 15th to June 30th dependent on flood control guidance from COE

River Forecast Center Volume Runoff Forecasts



	January	February	March	April	Current
NWRFC	6009	5655	5015	5294	4729
NRCS	6380	5930	5670	5380	
Avg KAF	5807	5807	5807	5807	5807


Questions?
Deb Mullowney
Northwestern Energy
Deb.Mullowney@northwestern.com
406-497-3509

Fire Season 2015

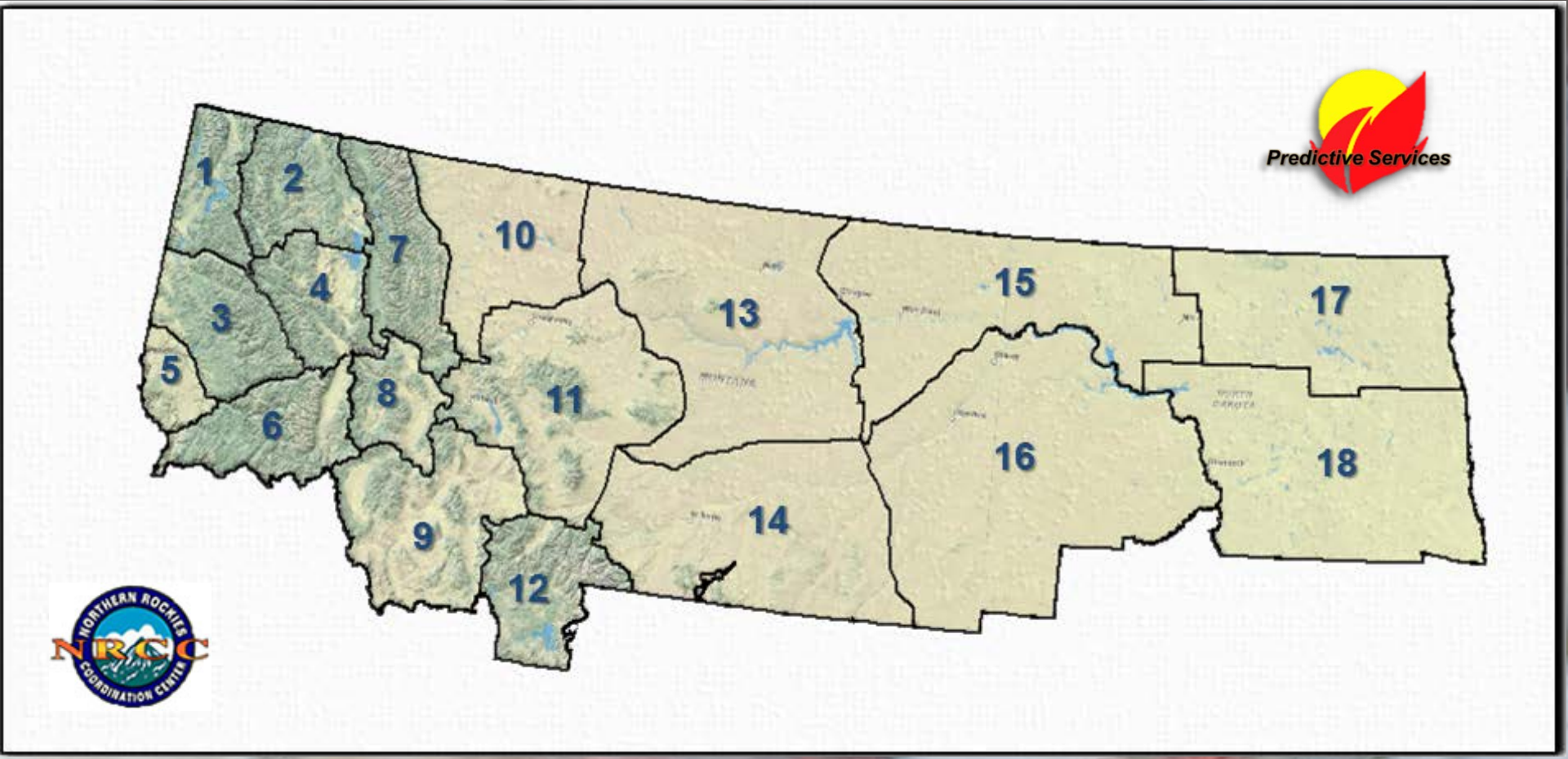
Predictive Services

23 April, 2015

Preliminary Outlook- NRGA

Michael Richmond
Meteorologist
NRCC

PSA Boundaries Revised in Early 2014



NR01 – North Idaho Panhandle
NR02 – Northwest Montana
NR03 – South Idaho Panhandle
NR04 – Western Montana
NR05 – Camas Prairie of Idaho
NR06 – North Central Idaho and Bitterroot/Sapphire Mountains
NR07 – Glacier NP and Wilderness Areas
NR08 – SW Montana West of the Continental Divide
NR09 – Big Hole/SW Montana East of the Continental Divide
NR10 – Northern Front Range
NR11 – West Central Montana
NR12 – South Central Montana and Yellowstone NP
NR13 – Northern Plains and Missouri Breaks
NR14 – Southern Montana (Big Horn/Powder River)
NR15 – NE Montana and NW North Dakota
NR16 – SE Montana and SW North Dakota
NR17 – Northeastern North Dakota
NR18 – Southeastern North Dakota

NR Predictive Services Not Fully Staffed in 2015

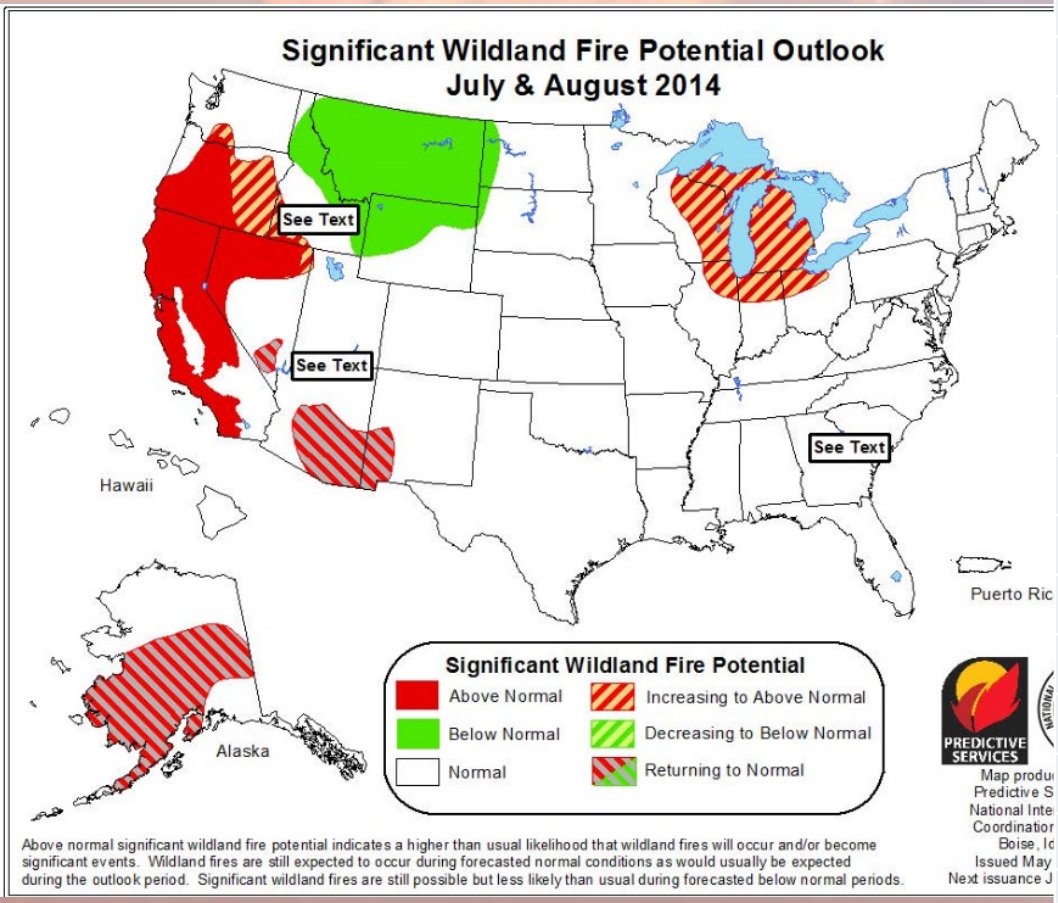
- Bryan Henry departed.
- Web briefings issued 3 times/week until June 1, then 5 days per week thereafter.
- Daily Outlooks and 7-Day Fire Potential Outlooks issued 5 days per week beginning June 2 through core season.

- As usual, close coordination with NWS partners will continue to ensure consistency of message.

10-Year Averages

COMBINED		WILDLAND FIRE 10-YEAR TOTALS		WILDLAND FIRE 10-YEAR AVERAGE	
		FIRES	ACRES	FIRES	ACRES
Bureau of Indian Affairs	BIA	8,400	666,505	840	66,651
Bureau of Land Management	BLM	1,025	569,039	103	56,904
Counties	CNTY	916	25,463	92	2,546
Department of Defense	DOD	4	0	0	0
Fish & Wildlife Service	FWS	270	134,210	27	13,421
National Park Service	NPS	244	87,651	24	8,765
Other	TRIBE	216	11,678	22	1,168
Private Land	PRI	3,793	883,064	379	88,306
State Agencies	ST	4,145	560,670	415	56,067
USDA Forest Service	USFS	8,784	2,034,163	878	203,416
10-YEAR TOTAL - ALL NRGA AGENCIES		27,797	4,972,443	2,780	497,244

Last Year's Outlook…



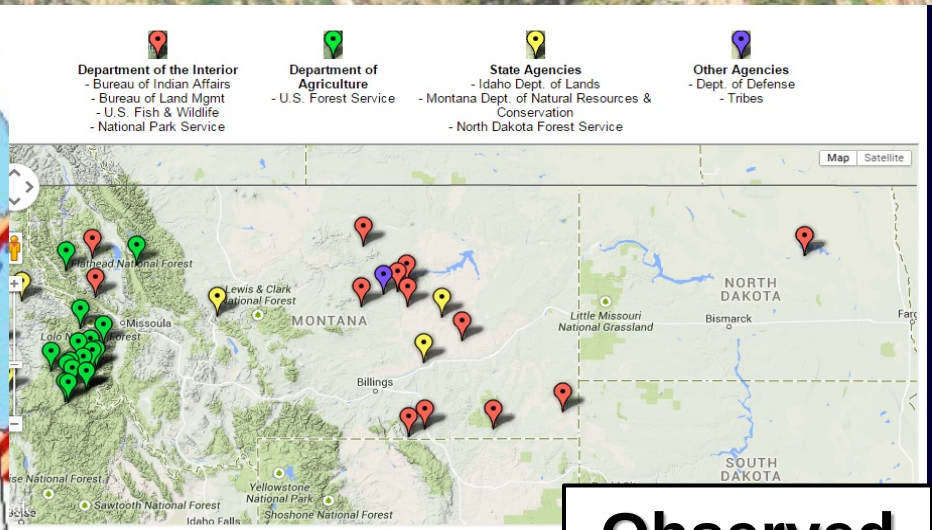
Acres Burned

2012	**1,497,972**
2006	1,201,117
2007	1,185,199
2000	1,087,920
2003	942,022
2008	241,854
2001	223,310
1999	218,106
2011	198,624
2005	185,457
2013	179,459
2002	172,197
1998	150,047
2014	**143,271**
2010	70,474
2009	69,016
2004	40,840
Median	**198,624**
Average	459,041

2014-By the Numbers

- 2014 was a below-average year. 143,271 acres burned from a total of 2,665 fires.
- The bottom left map represents the official outlook. The bottom right map shows the observed fire activity.

Predicted



Observed

- *2014 Season was well-behaved ☺*

Acres Burned-The Rankings

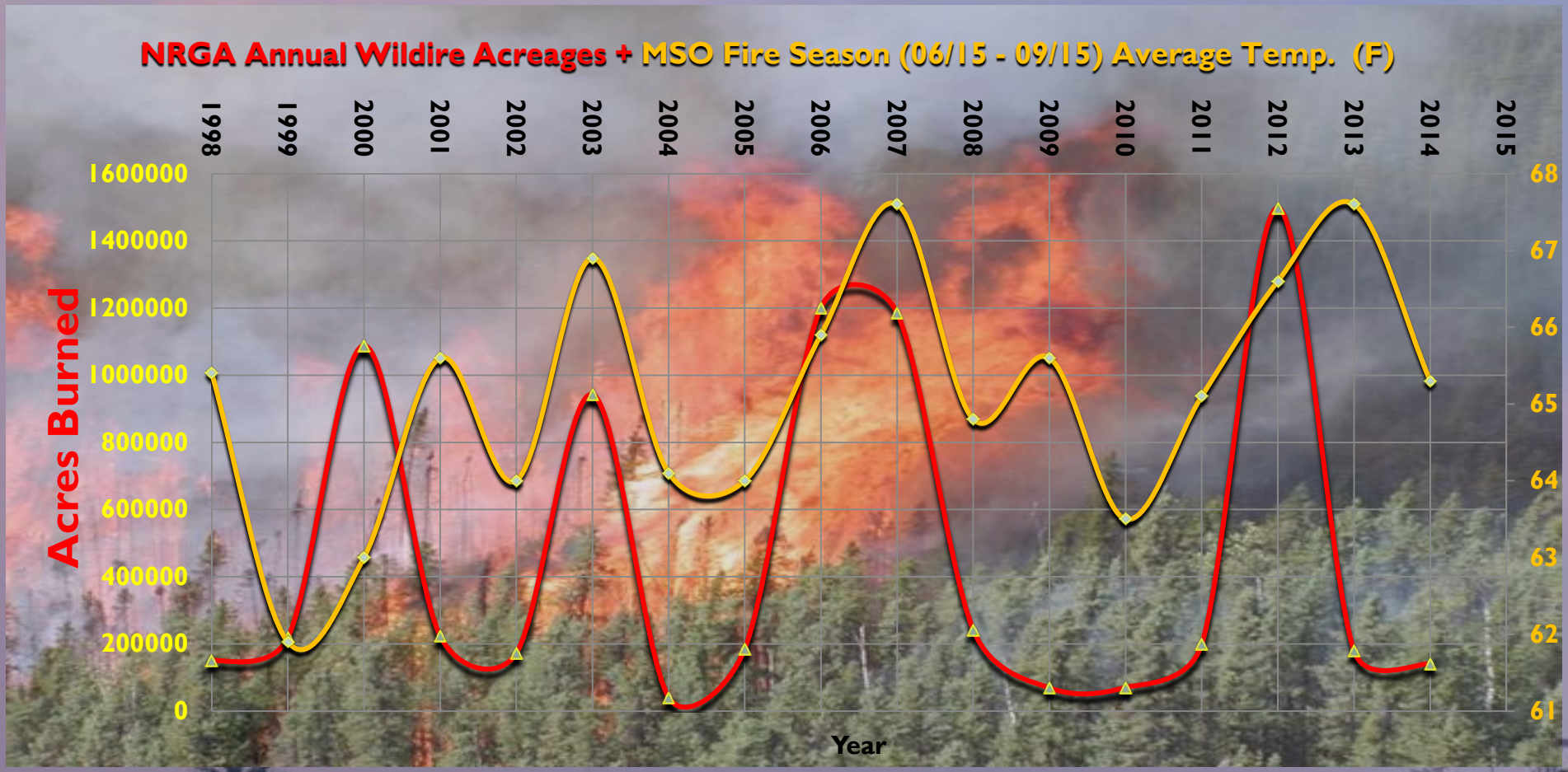
2012 – 1,497,972

2006 – 1,201,117

2007 – 1,185,199

2000 – 1,087,920

2003 - 942,022

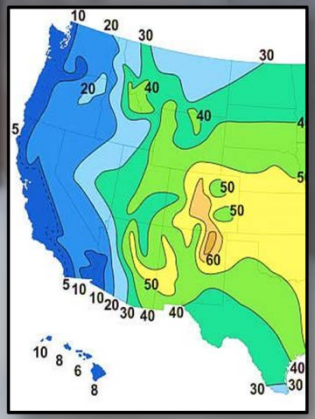


Factors that Influence Fire Season Severity

July Temperatures and Precipitation

Summer Convection

Number of Thunderstorm Days/Year (NOAA)



Indicators suggest above-normal temperatures and near-normal precipitation to continue.

Spring Factor

Ocean/Atmospheric Circulations (ENSO/PDO/etc.)

**Snowpack melting rates are much more important than snow pack accrual!*

Winter Snowpack

Fall was "near average" across North ID/Western/Central MT. Slightly below normal on precip Eastern MT and ND

Fall Moisture and Preexisting Drought Conditions

Start - Fall

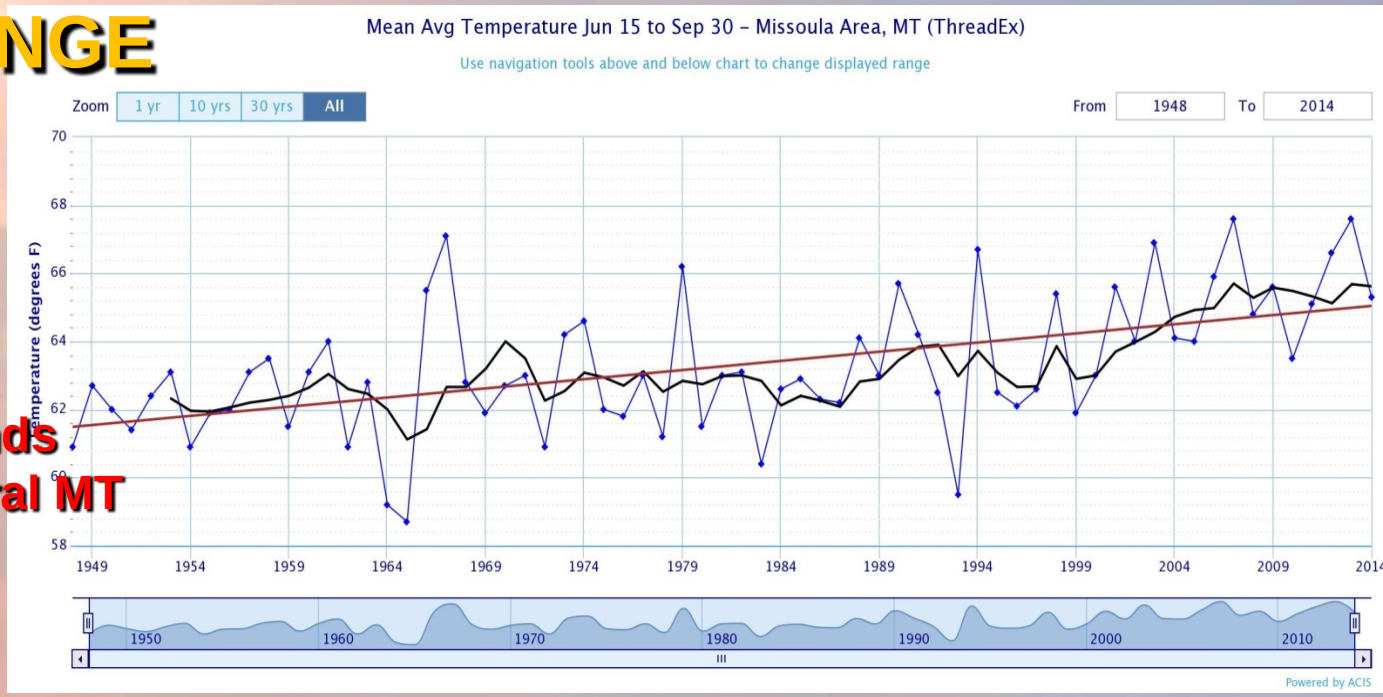
Live/Dead Fuel Moisture

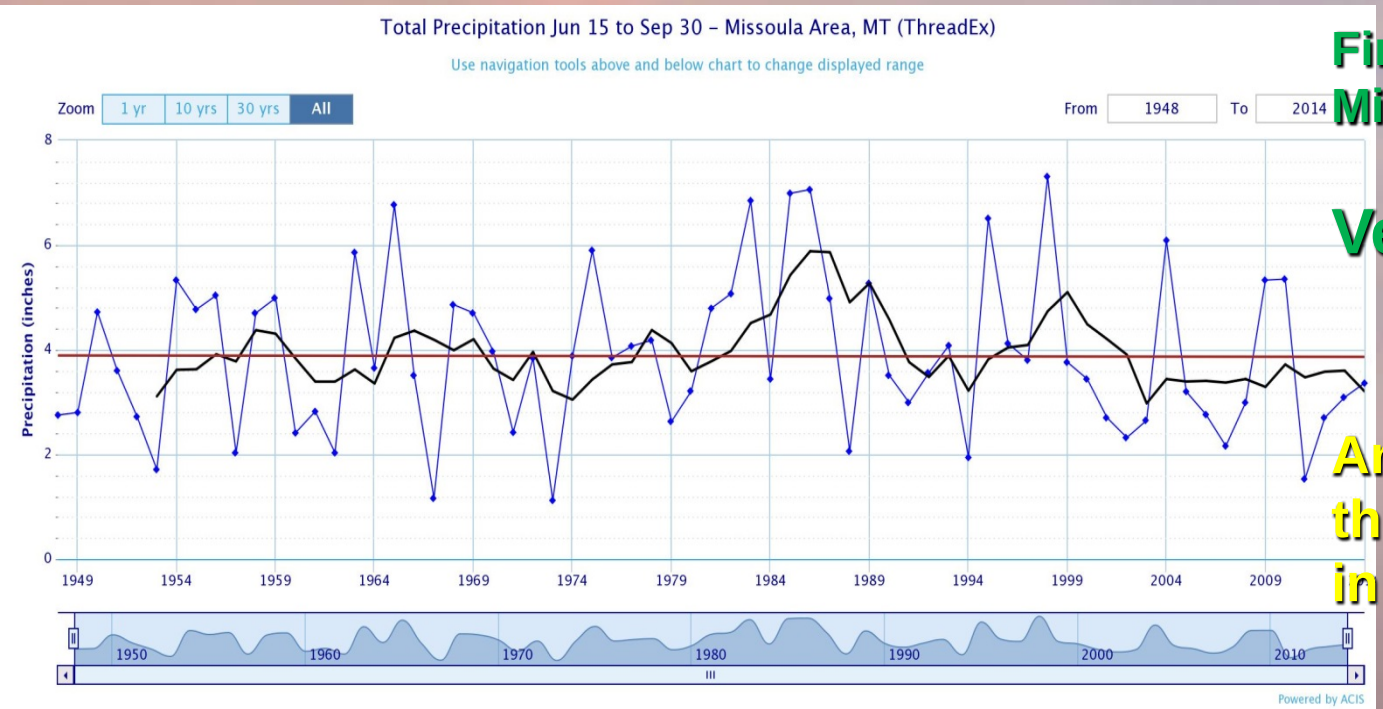
CLIMATE CHANGE IN THE NRGA

Fire Season Temps. in Missoula, 1948-2014

Representative of Trends for N ID and Wrn/Central MT

+3F Increase





Fire Season Precip. in Missoula 1948-2014.

Very Little Change.

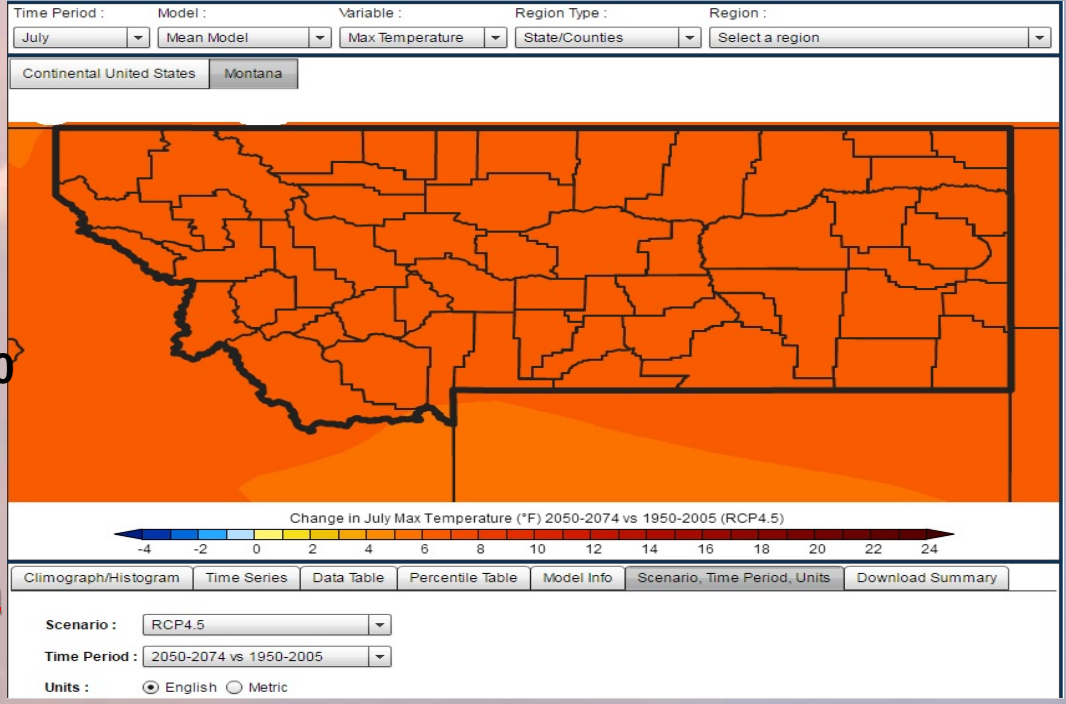
Are weather patterns therefore changing in the NRGA?

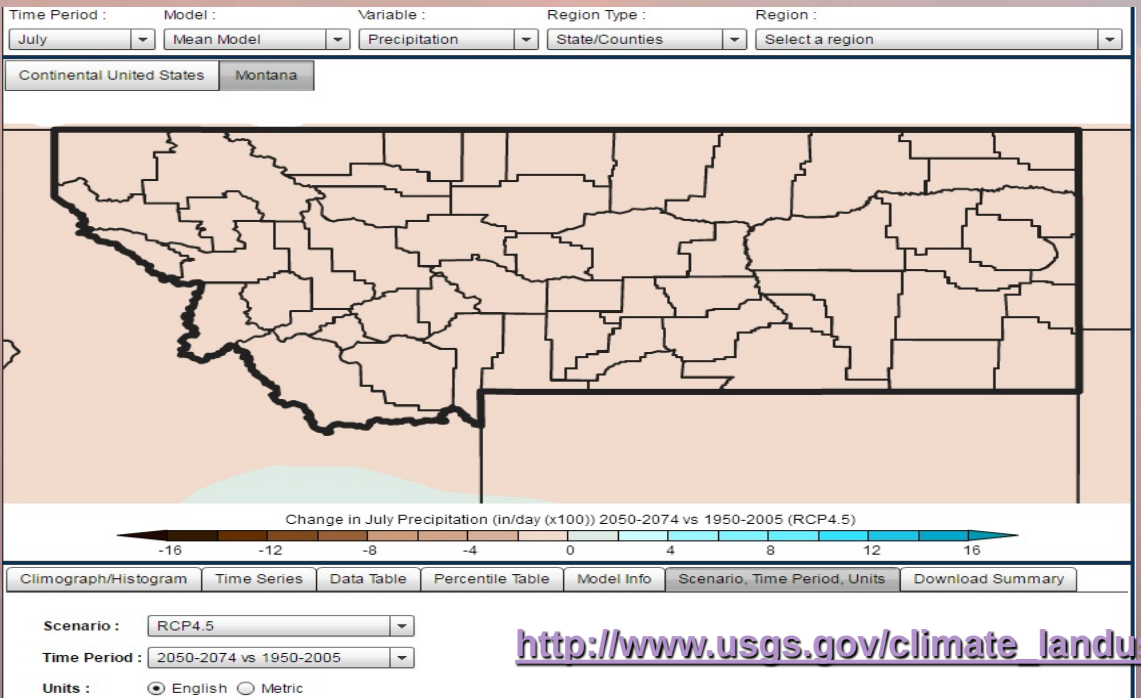
LOOKING AHEAD:

USGS Climate Change Viewer

Mean model results assuming some CO2 emissions control resulting in level of 640 ppm CO2 (400 ppm currently) year 2100.

Average July Maximum Temps. Increase 5-7F across all Montana and Idaho period 2050-2074.





Mean model results show very slight decrease in average July Precip. period 2050-2074.

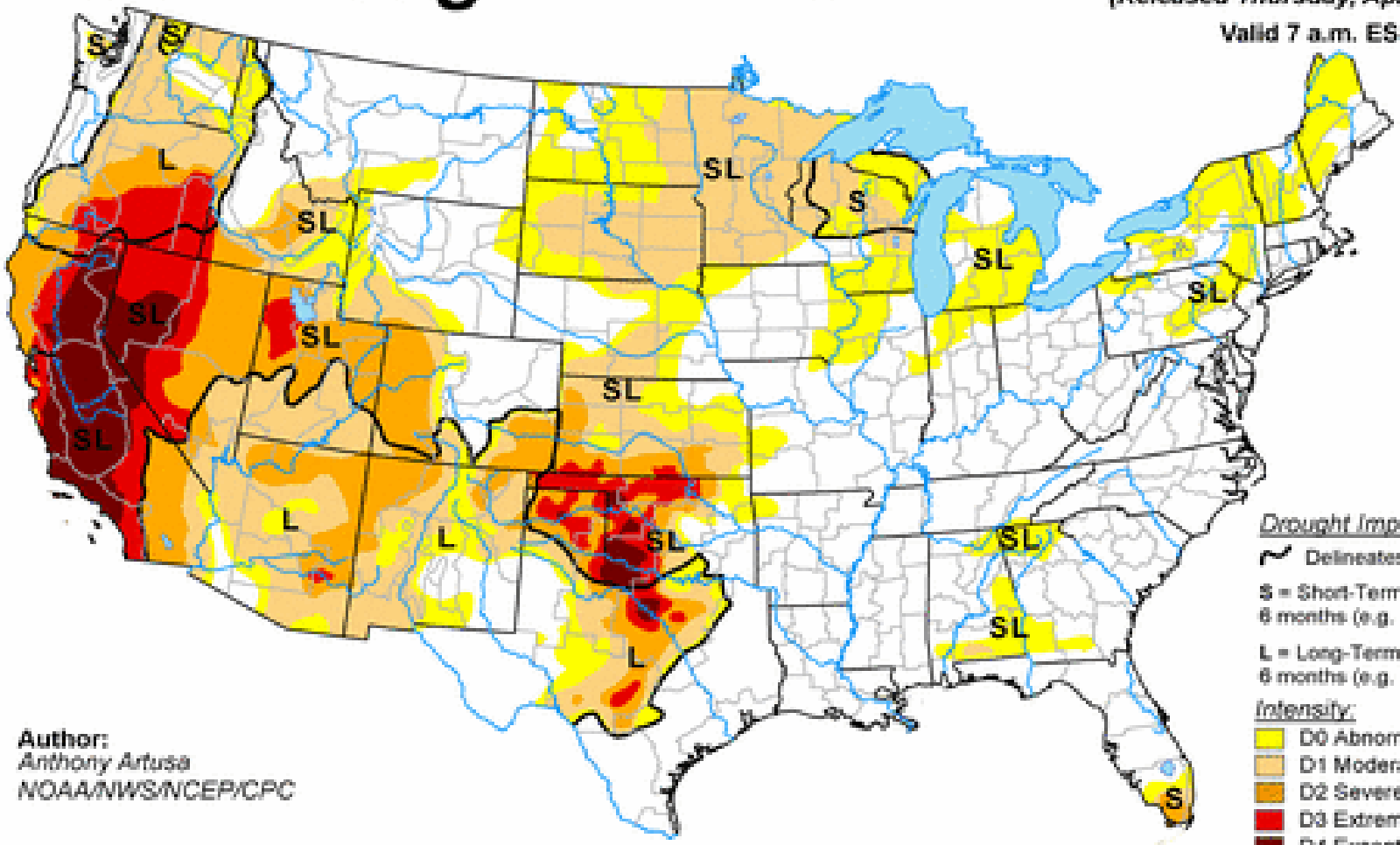
http://www.usgs.gov/climate_landuse/clu_rd/apps/nccv_viewer.asp

U.S. Drought Monitor

April 21, 2015

(Released Thursday, Apr. 23, 2015)

Valid 7 a.m. EST



Author:
Anthony Artusa
NOAA/NWS/NCEP/CPC

Drought Impact Types:

~ Delineates dominant impacts

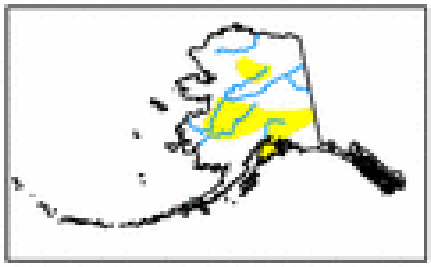
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

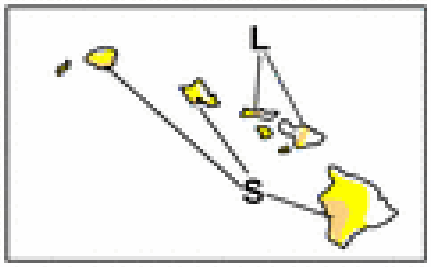
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

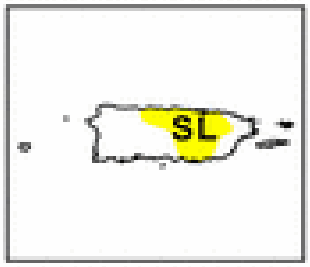
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.







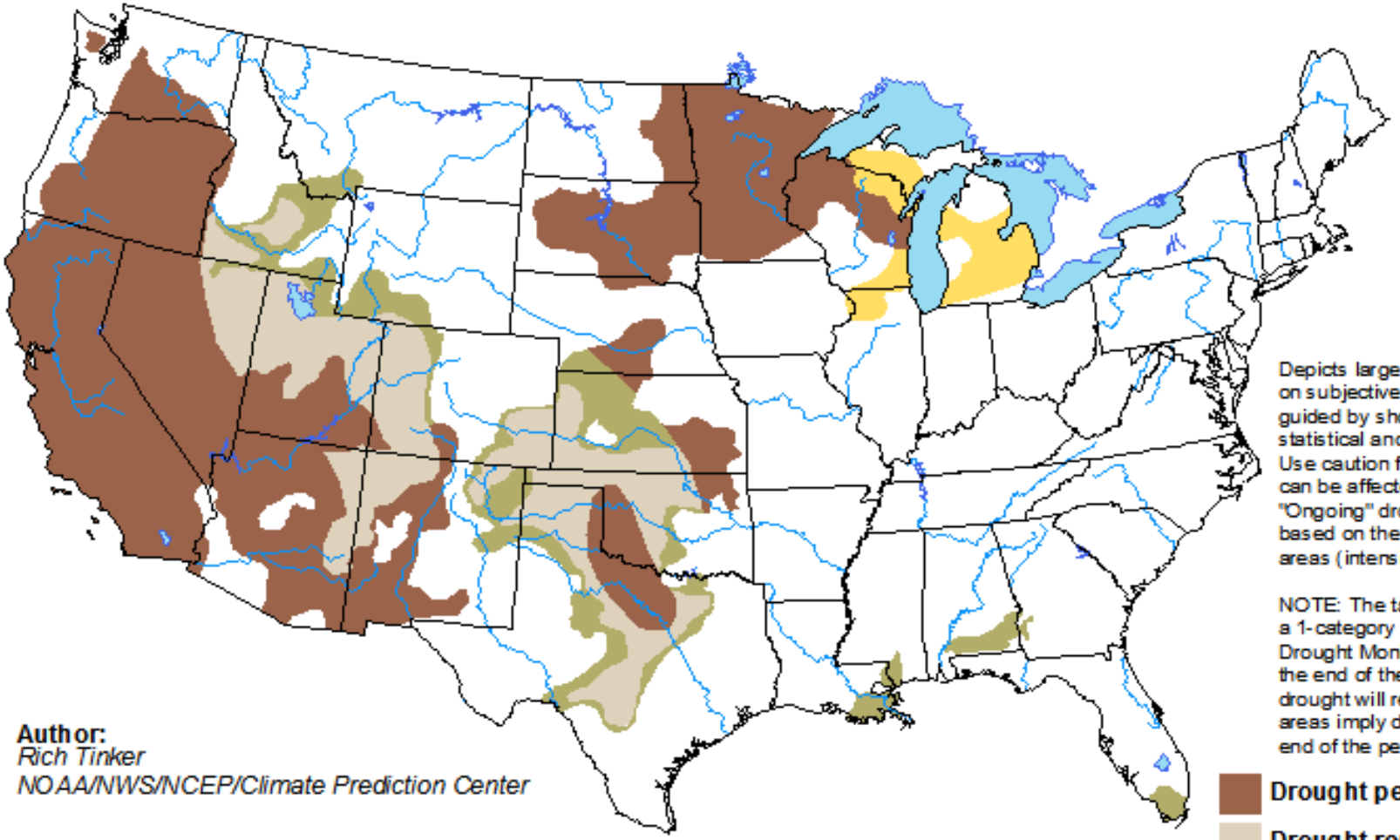
USDA

http://droughtmonitor.unl.edu/

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for April 16 - July 31, 2015
Released April 16, 2015

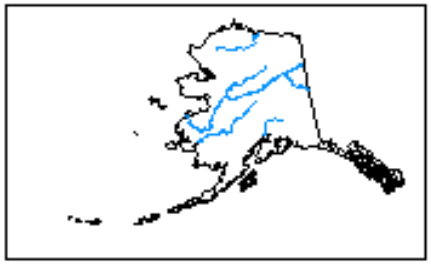


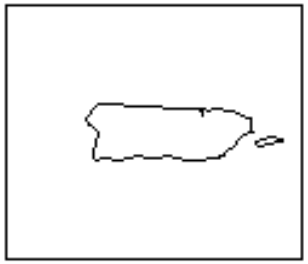
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

- Drought persists/intensifies
- Drought remains but improves
- Drought removal likely
- Drought development likely

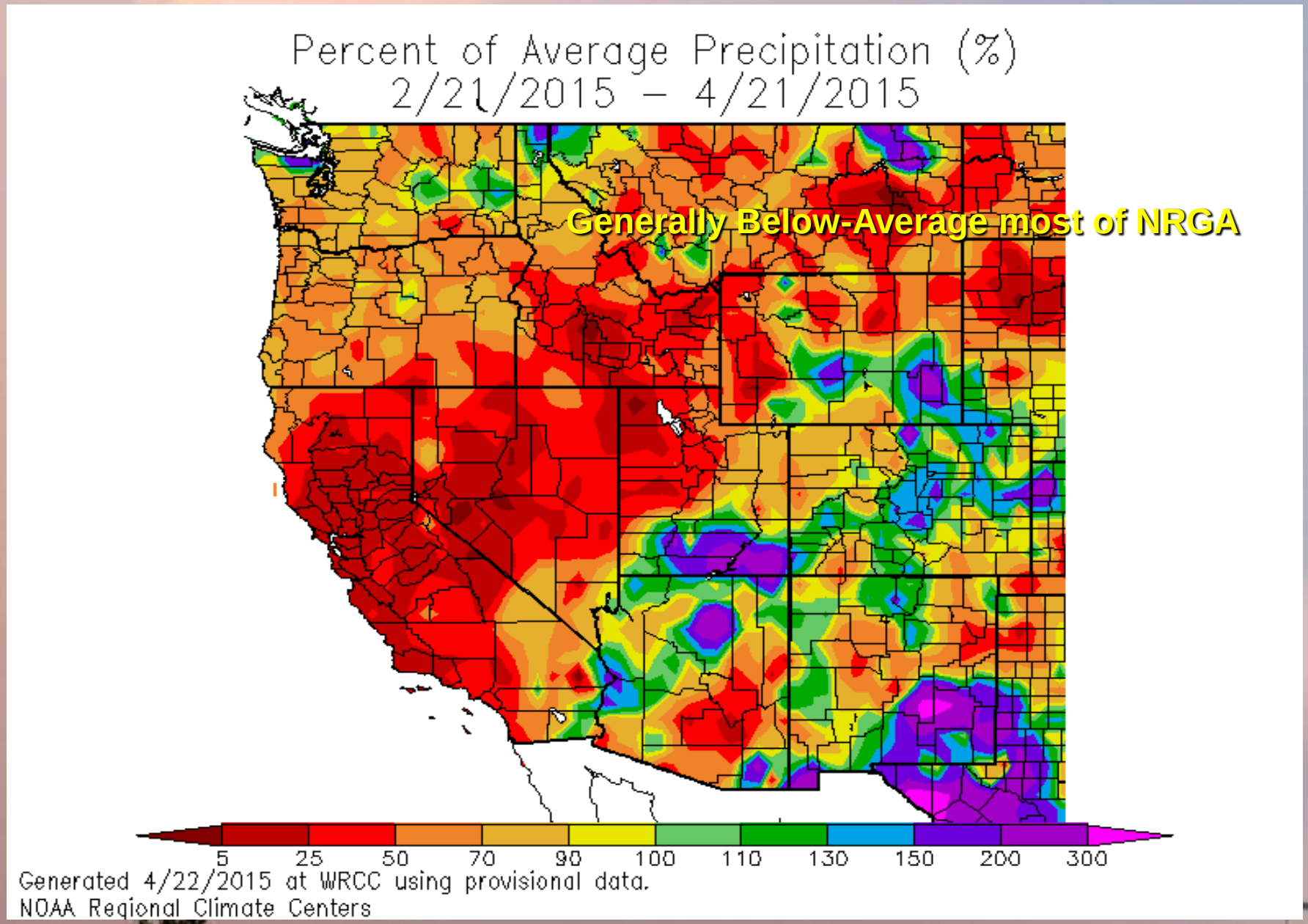
Author:
Rich Tinker
NOAA/NWS/NCEP/Climate Prediction Center



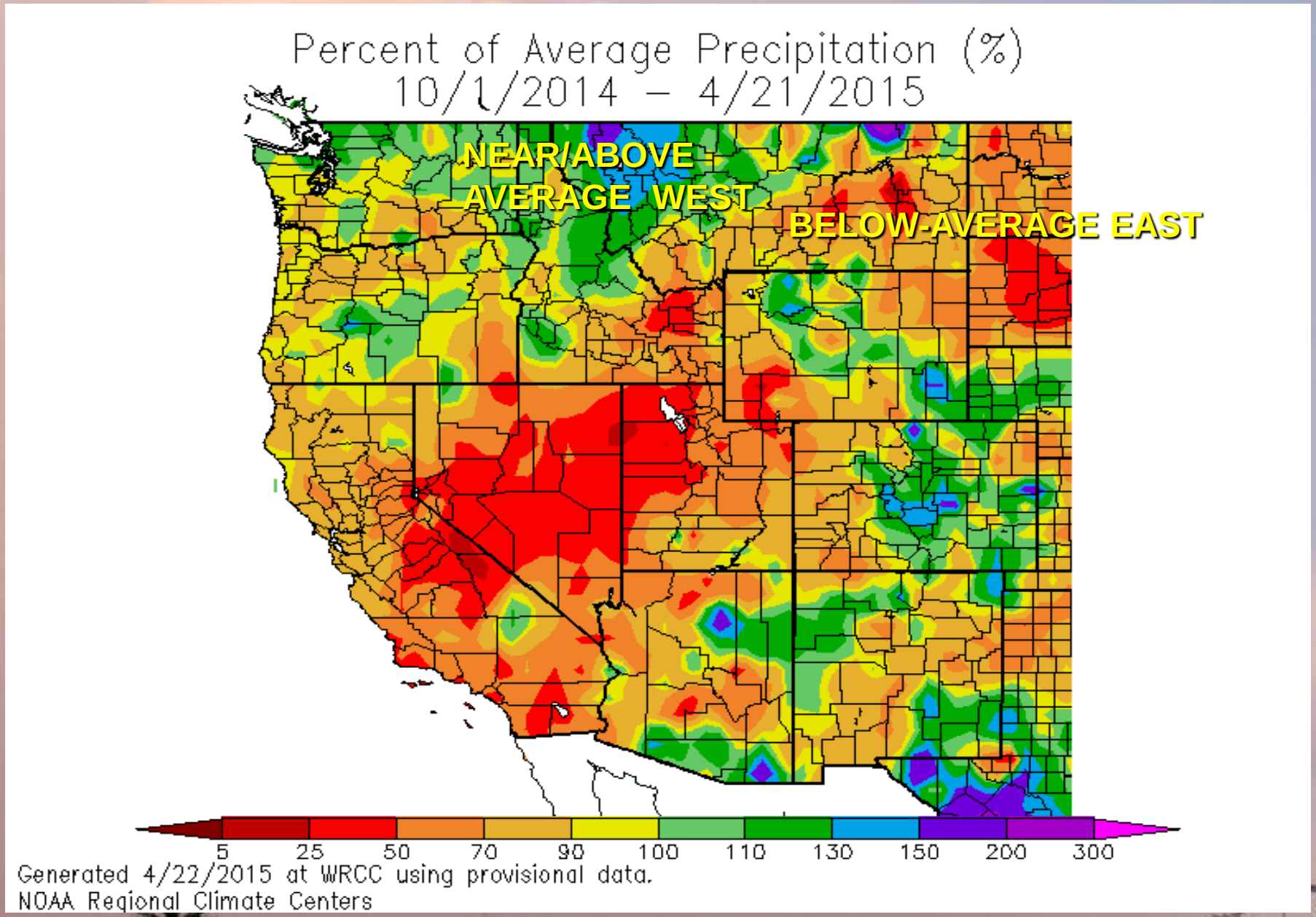


http://go.usa.gov/hHTe

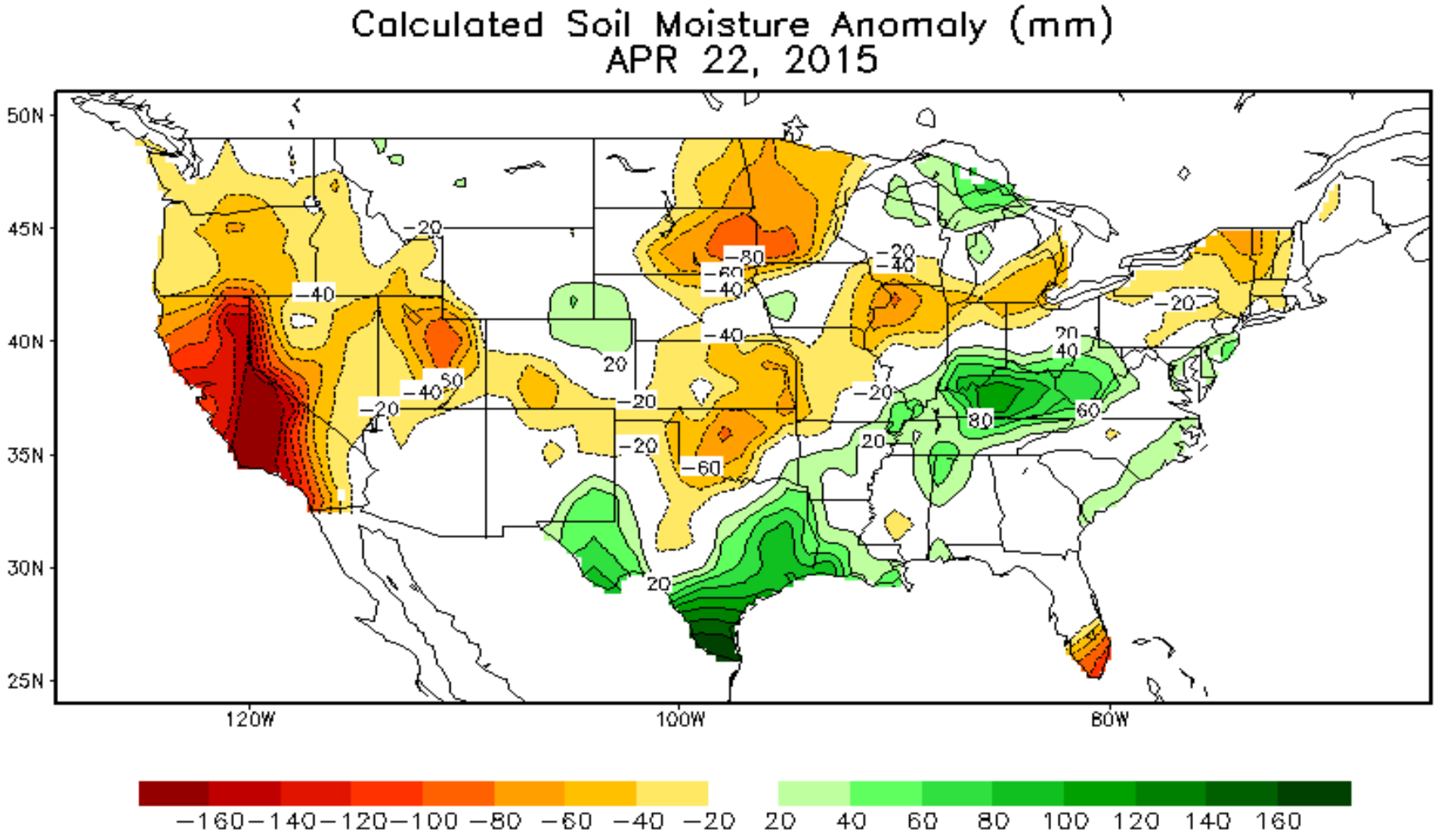
Percent of Normal Precipitation (Last 60 days)



WATER – YEAR PRECIP – NRGA

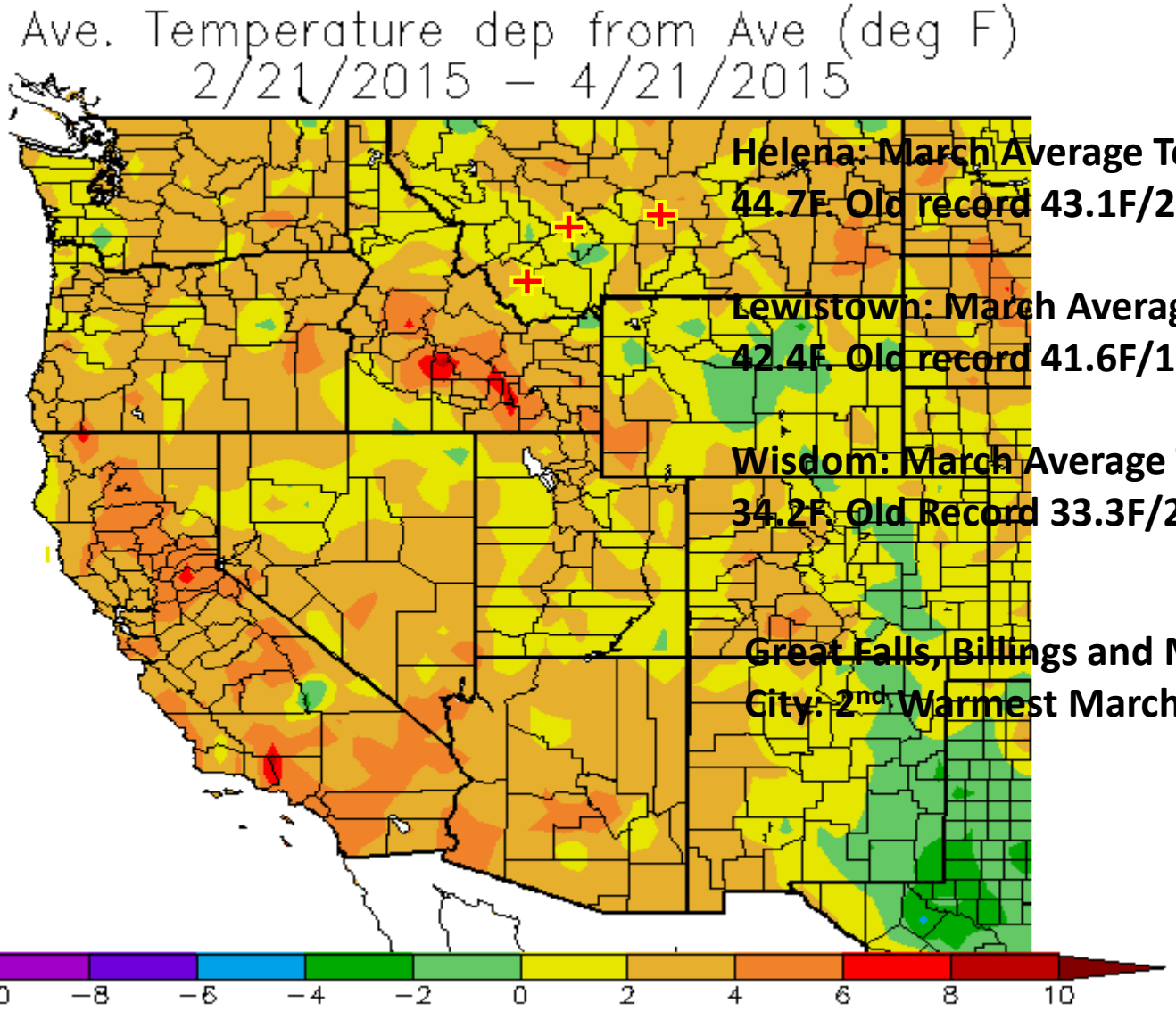


Soil Moisture Anomalies: CA and NV still very dry. Slightly above-average northern MT. Drier than average Eastern ND, parts of Idaho.



60 Day Temp. Summary: Well Above-Average Temps most NRGA.

3 records set Warmest March: Helena, Lewistown, Wisdom



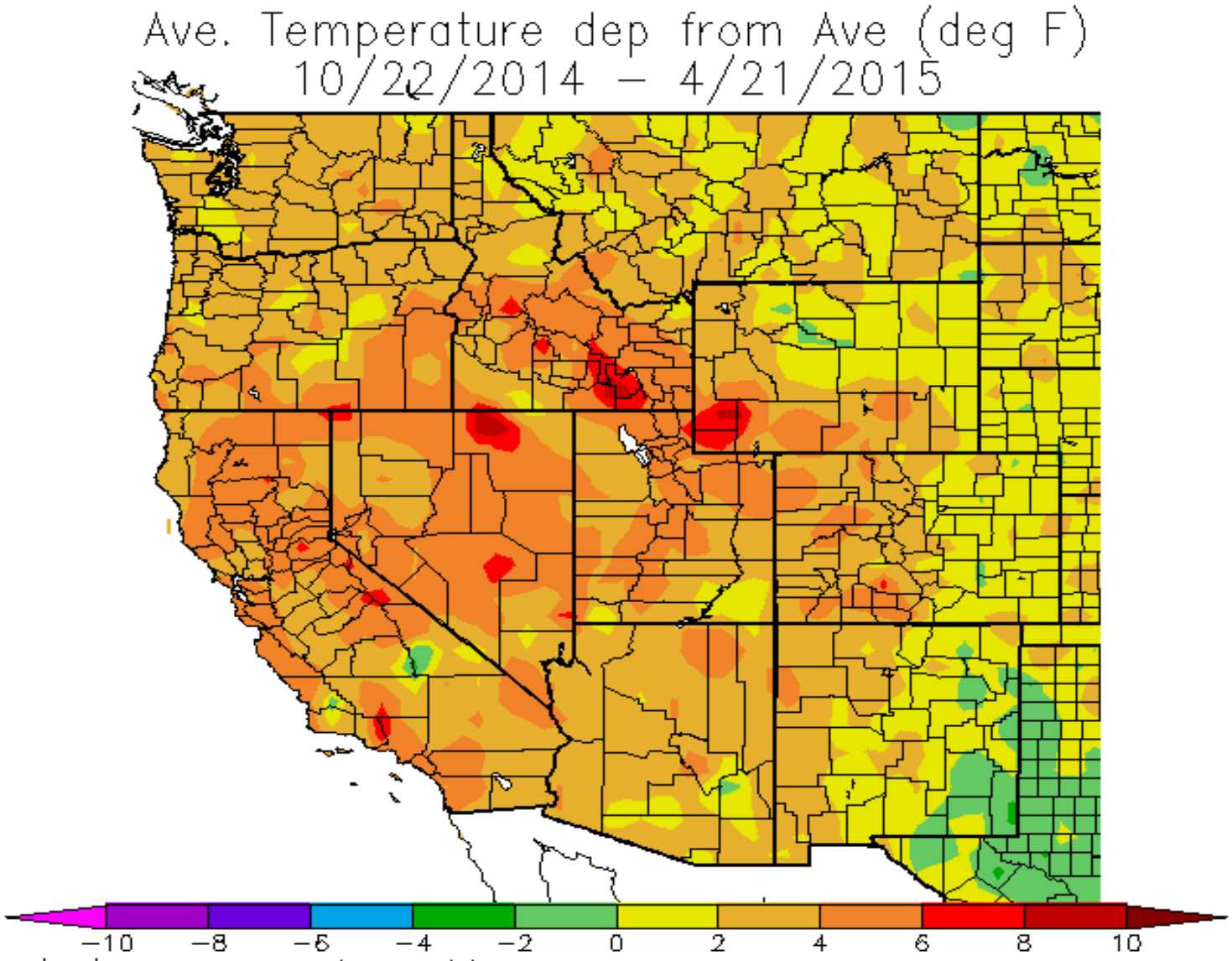
Helena: March Average Temp.: 44.7F. Old record 43.1F/2007

Lewistown: March Average Temp.: 42.4F. Old record 41.6F/1986

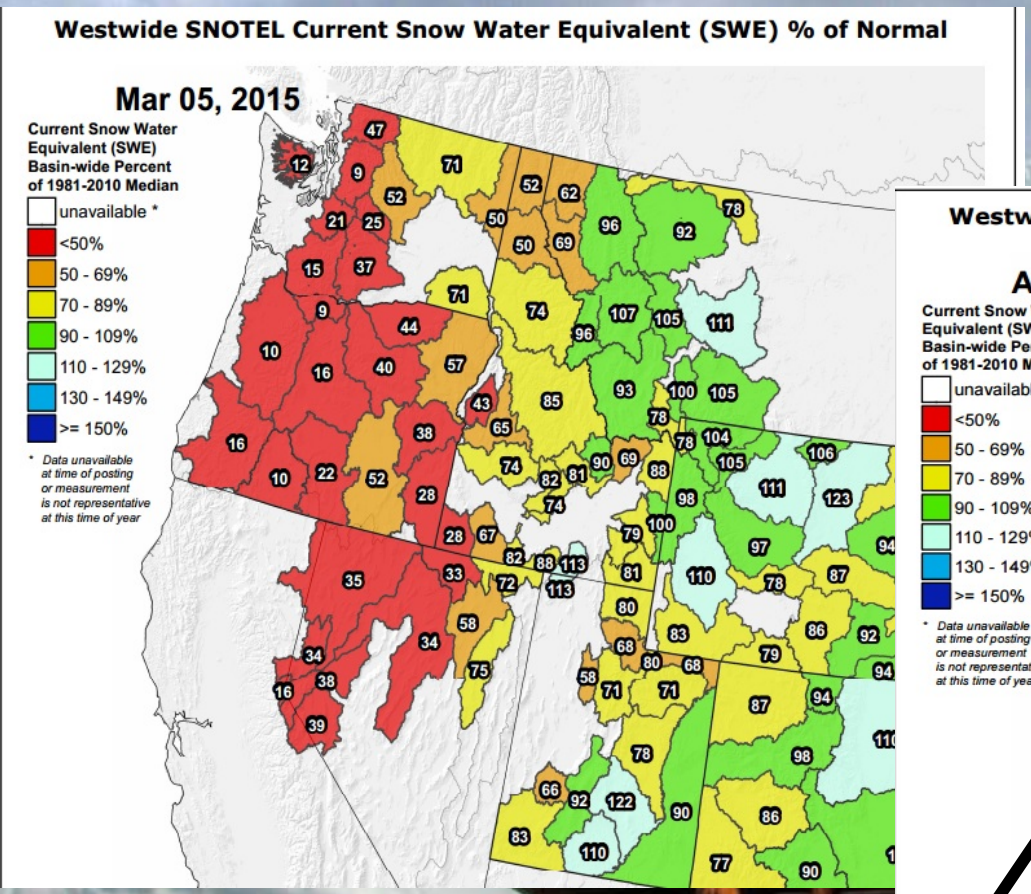
Wisdom: March Average Temp.: 34.2F. Old Record 33.3F/2007

Great Falls, Billings and Miles City: 2nd Warmest March Ever

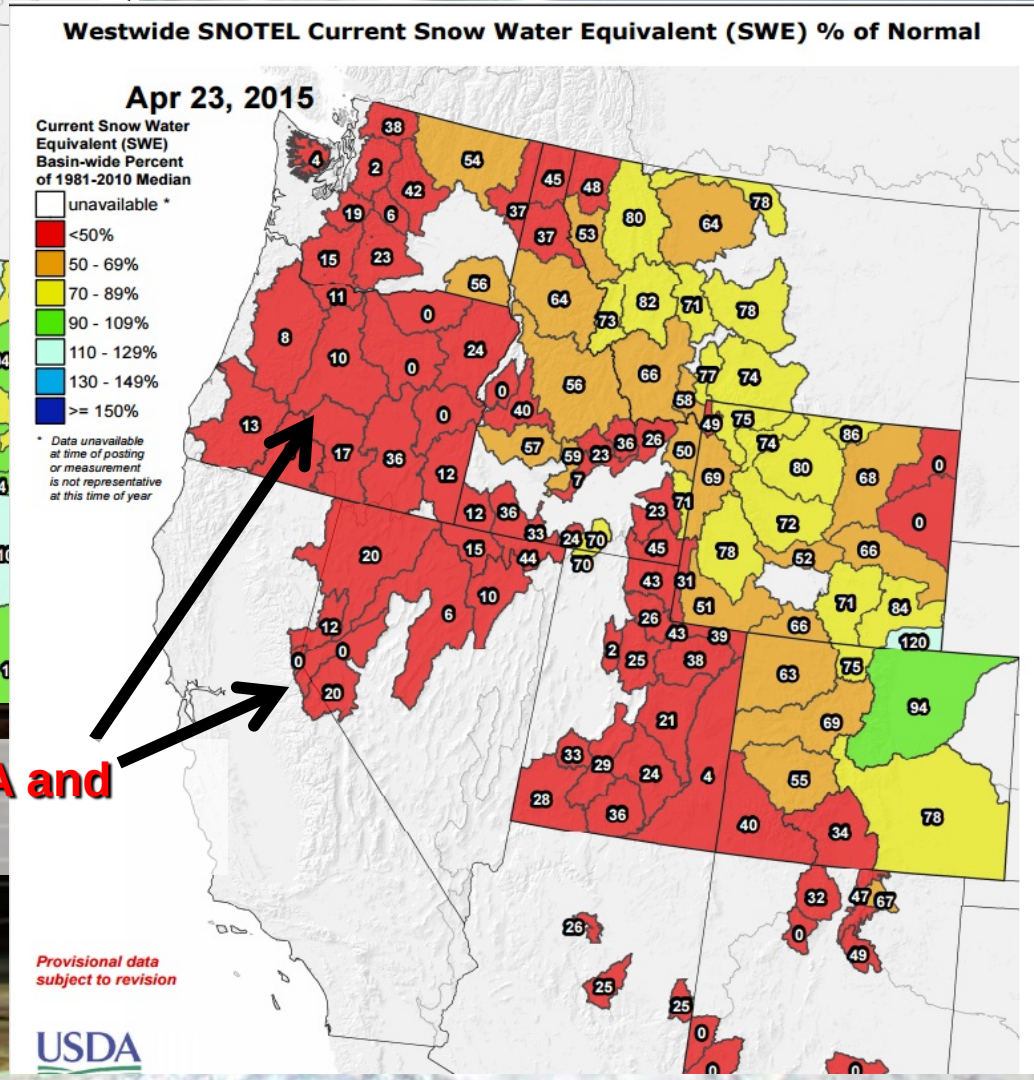
6-Month (Fall/Winter) Temp. Summary: Well above-average Temps Montana and Idaho. Near-Average Temps North Dakota



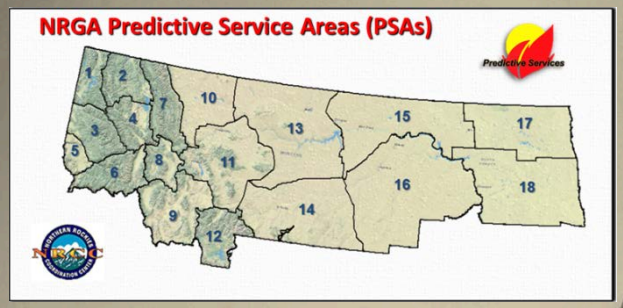
Snowpack (SWE)



Dropped fast NRGA under very warm temps. since late January.



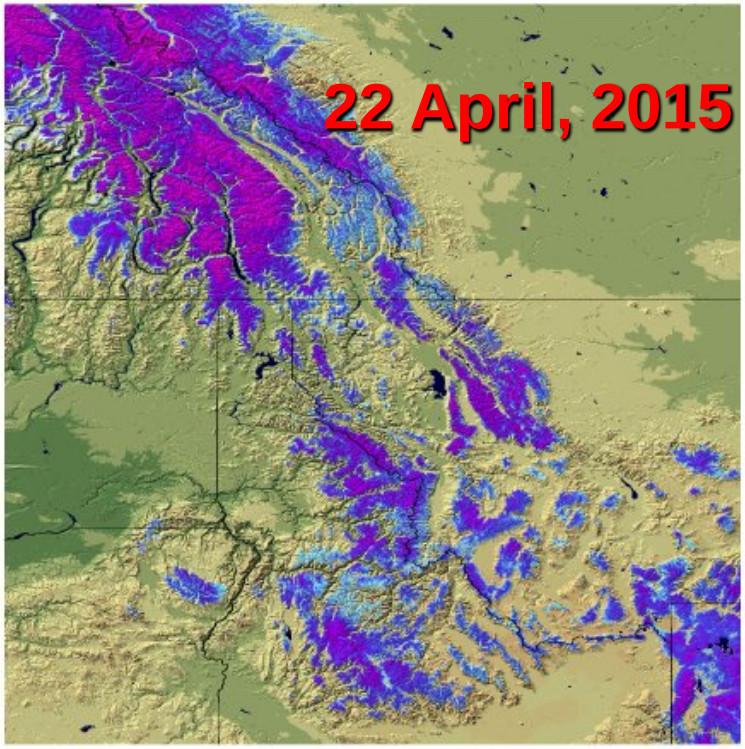
Record low values CA and Cascades of OR/WA

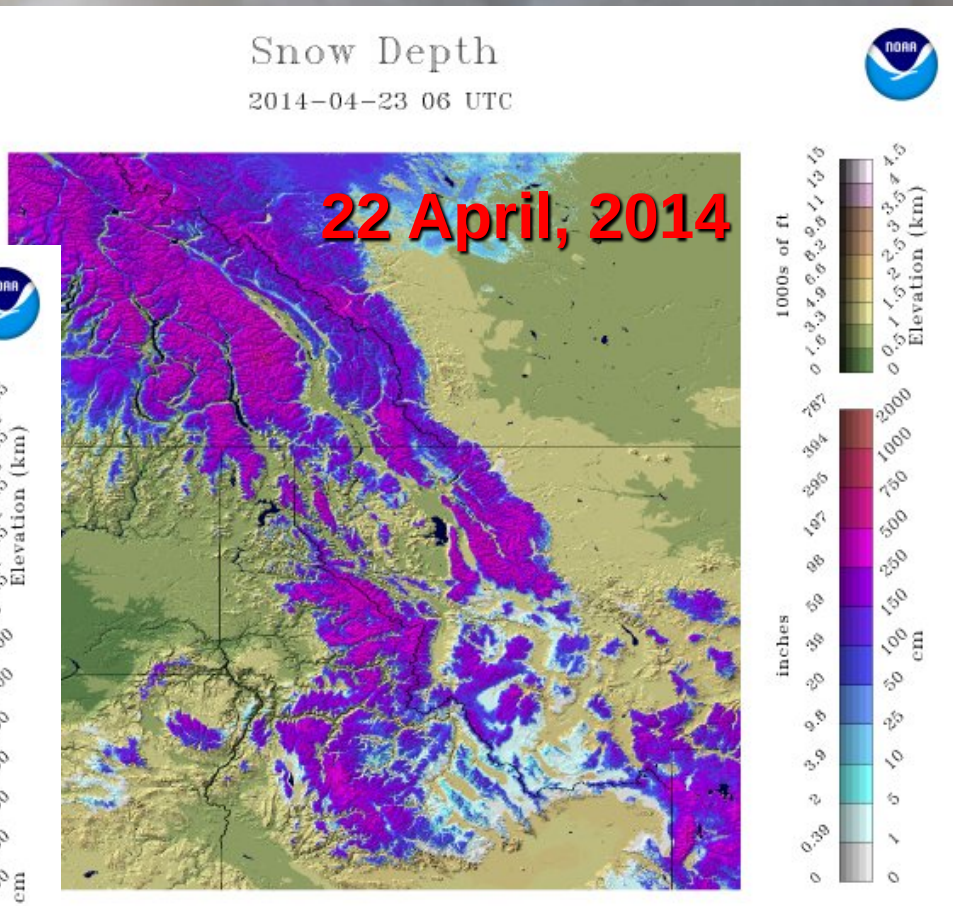


Well-Below average snowpacks in PSAs 1-2-3-4-5-6. Duration/timing of melt more important than actual amounts.

CPC 30 and 90 day outlooks maintain above-average Temps. through Spring and Summer.

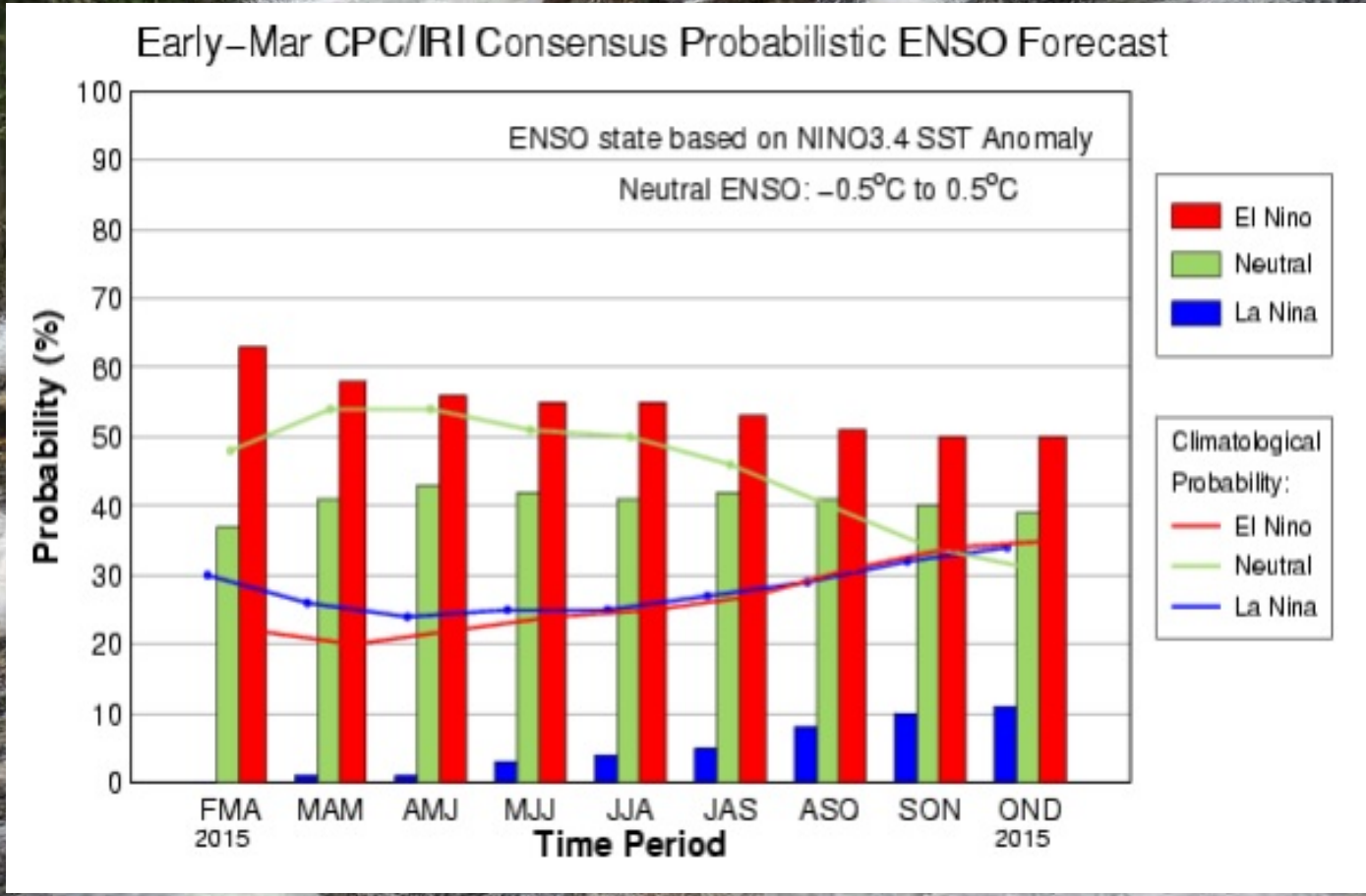
What a Difference One Year Makes!





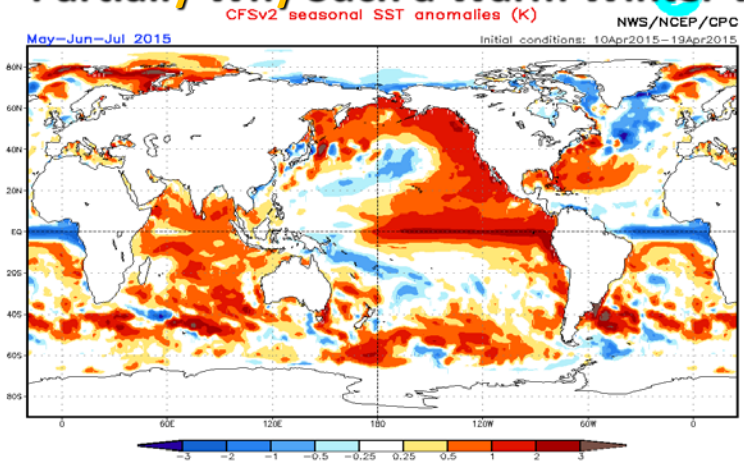
A weak El Nino is currently occurring. And may continue through the summer.

Summer El Nino's have only very small effect on NRGA conditions.

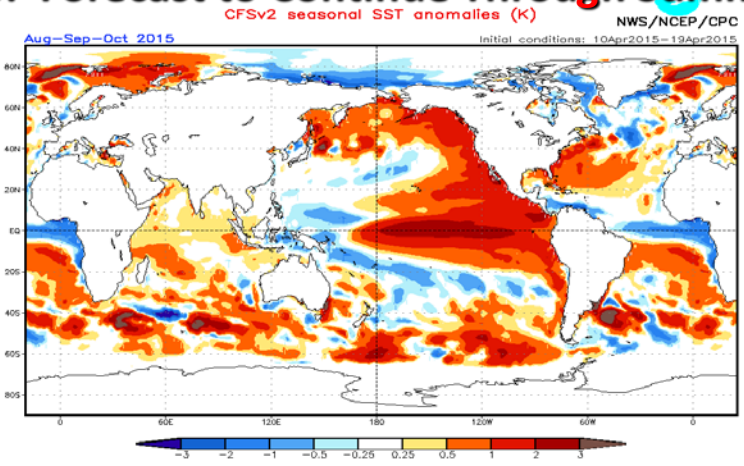


PERSISTENT EASTERN PACIFIC WARM SEA-SURFACE TEMPERATURE (SST) ANOMALIES:

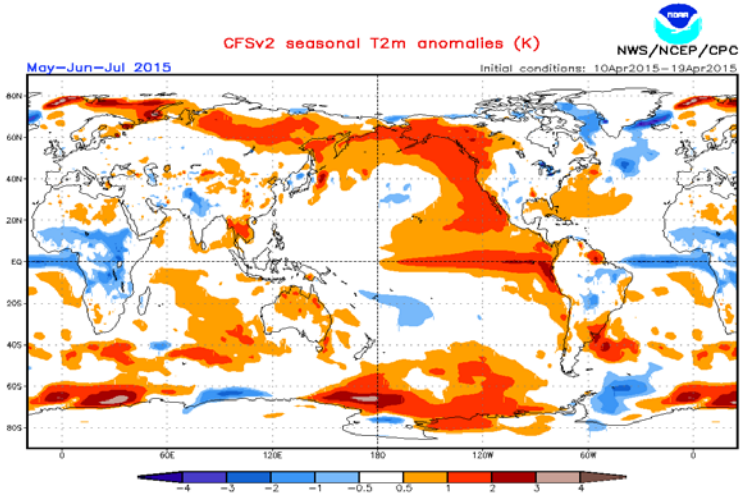
Partially Why Such a Warm Winter Western US.

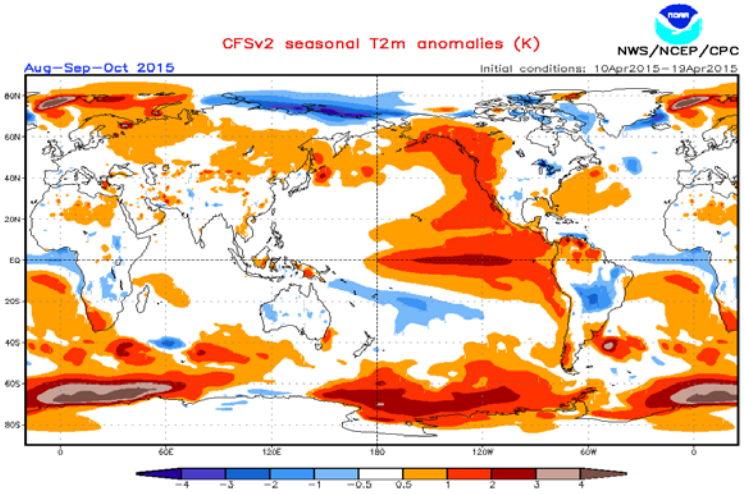


Forecast to Continue Through Summer.



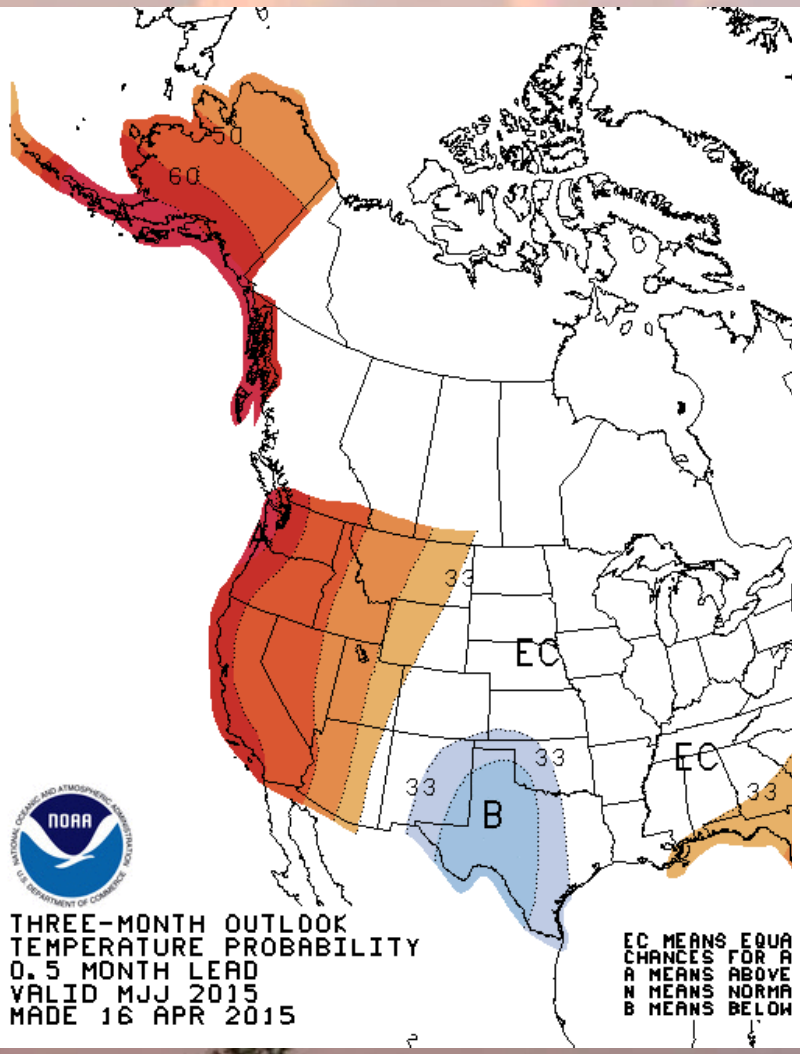
Leading to Likelihood of Continued Warmth Western US Through Summer

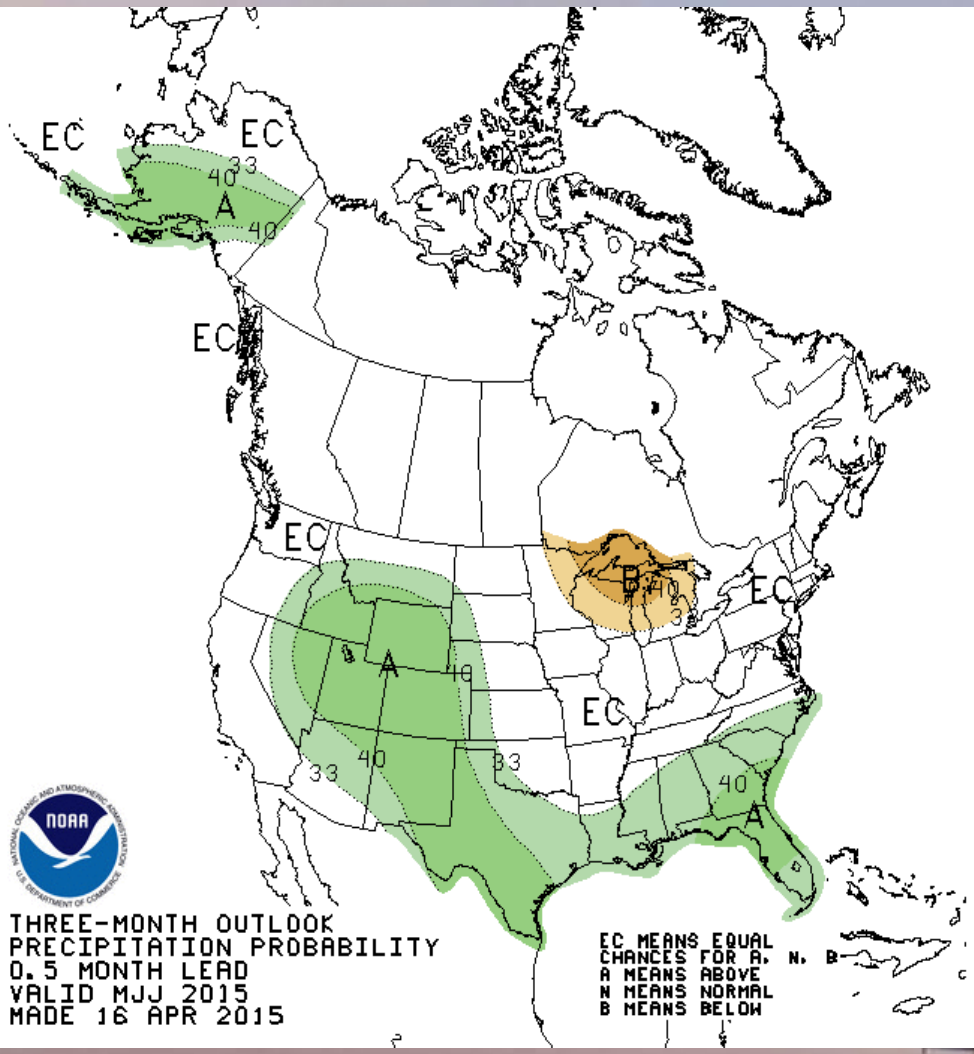




CPC Outlooks (Spring/Summer 2015 May-June-July)

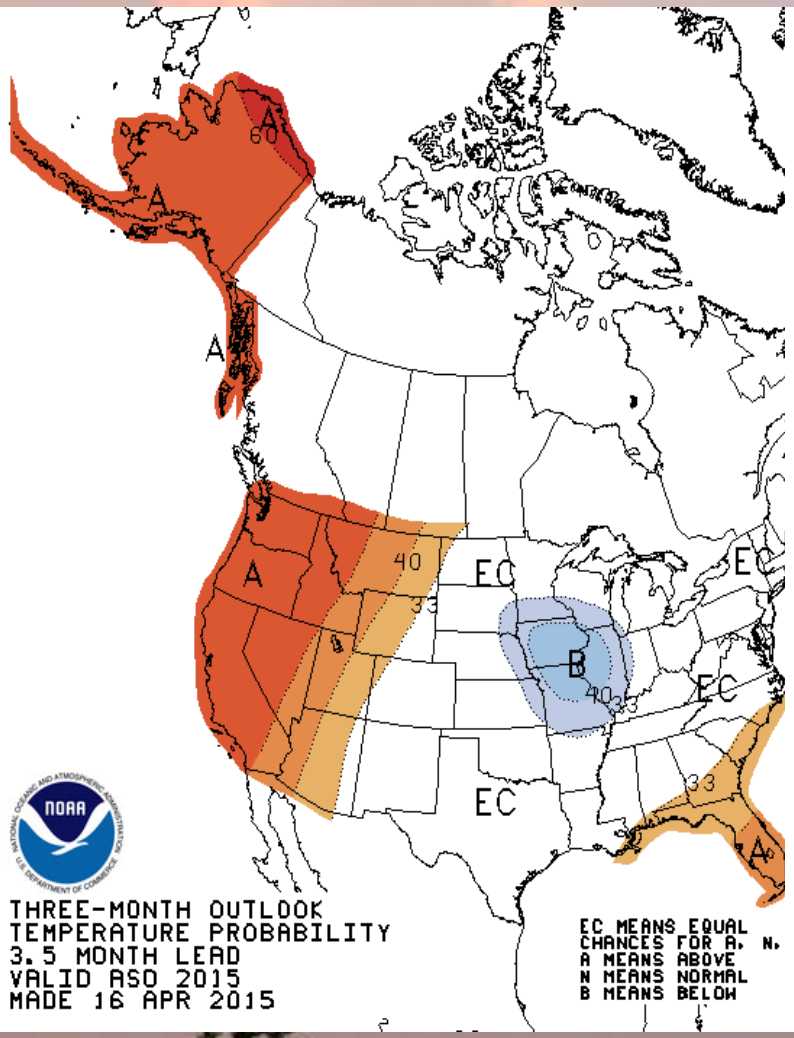
Continued Fast Snowpack Melt-Off, followed by Warm July?

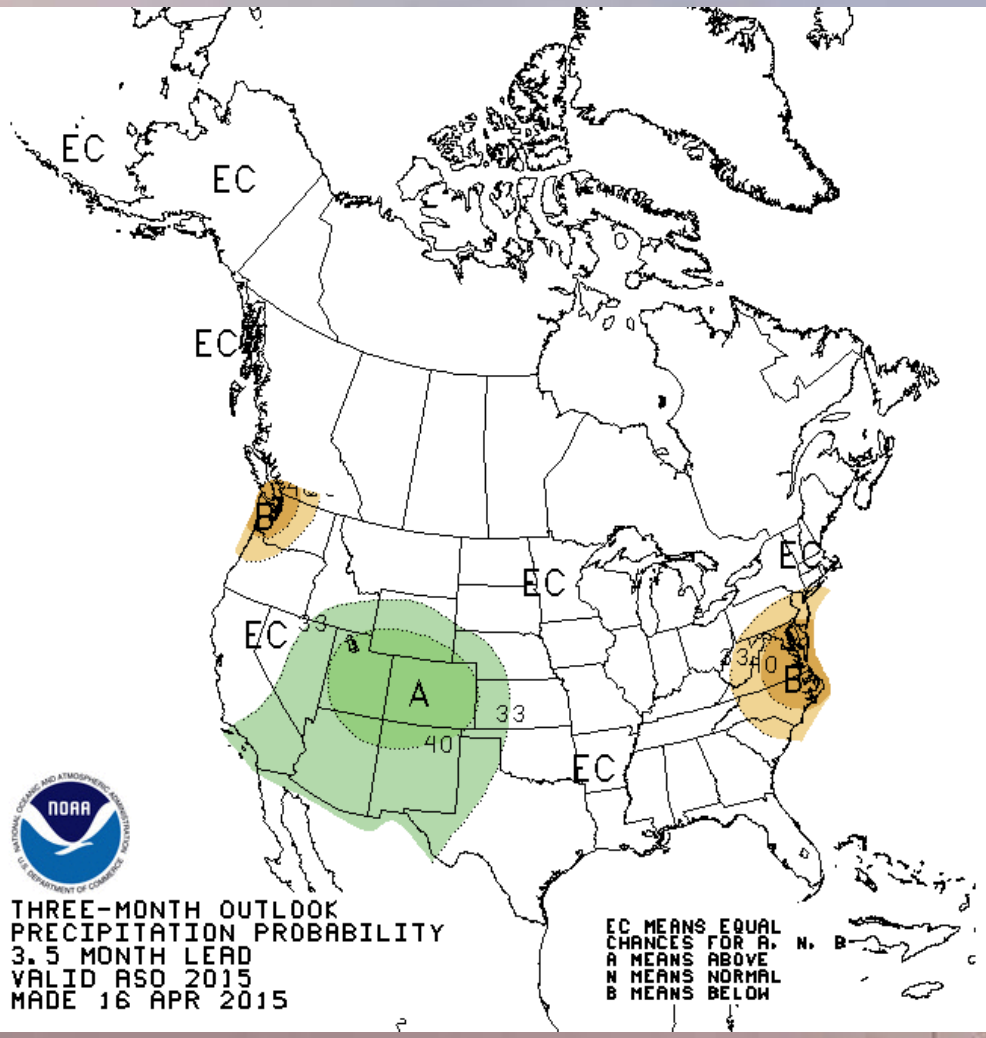




Outlooks for Summer/Early Fall (Aug-Sept-Oct)

Warmer Than Average Extended Summer with Near-Average Rainfall, Preceded by Warmer Spring/Faster Snowpack Melt-Off ?



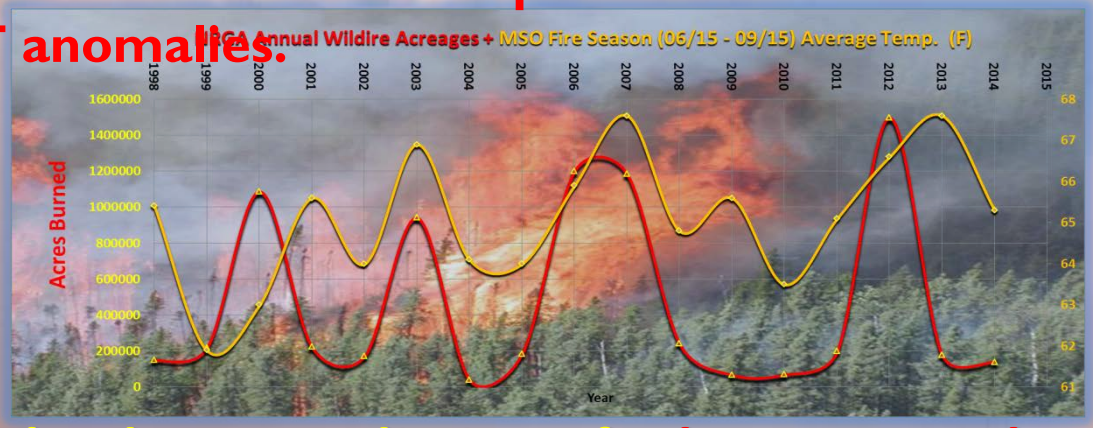


Outlook Recipe

- ENSO
- PDO
- Drought
- Climatology
- Long Range Outlooks
- Snow Accrual
- Snow Loss Rates
- Previous Fall Weather
- Soil Moisture

Thoughts on Fire Season 2015

- Only slight drought signals so far in North ID and eastern ND. Plains early fire season declining with Green-Up.
- Snowpack is **WELL** below average North ID/NW MT, below average rest of MT.
- Rest of spring should continue the above-normal temperatures with continued near-normal precipitation. **Leading to continued faster snowpack melt**.
- Only weak El Nino at best will continue through summer; most similar years were 2009, 2004, 2002, and 1991-92. None of these were severe fire seasons except for possibly 1991. **Historical NRGA cycle ambiguous. However CPC summer Temp. outlook maintains warmer than normal temps. ID and western MT due to Eastern Pacific SST anomalies.**

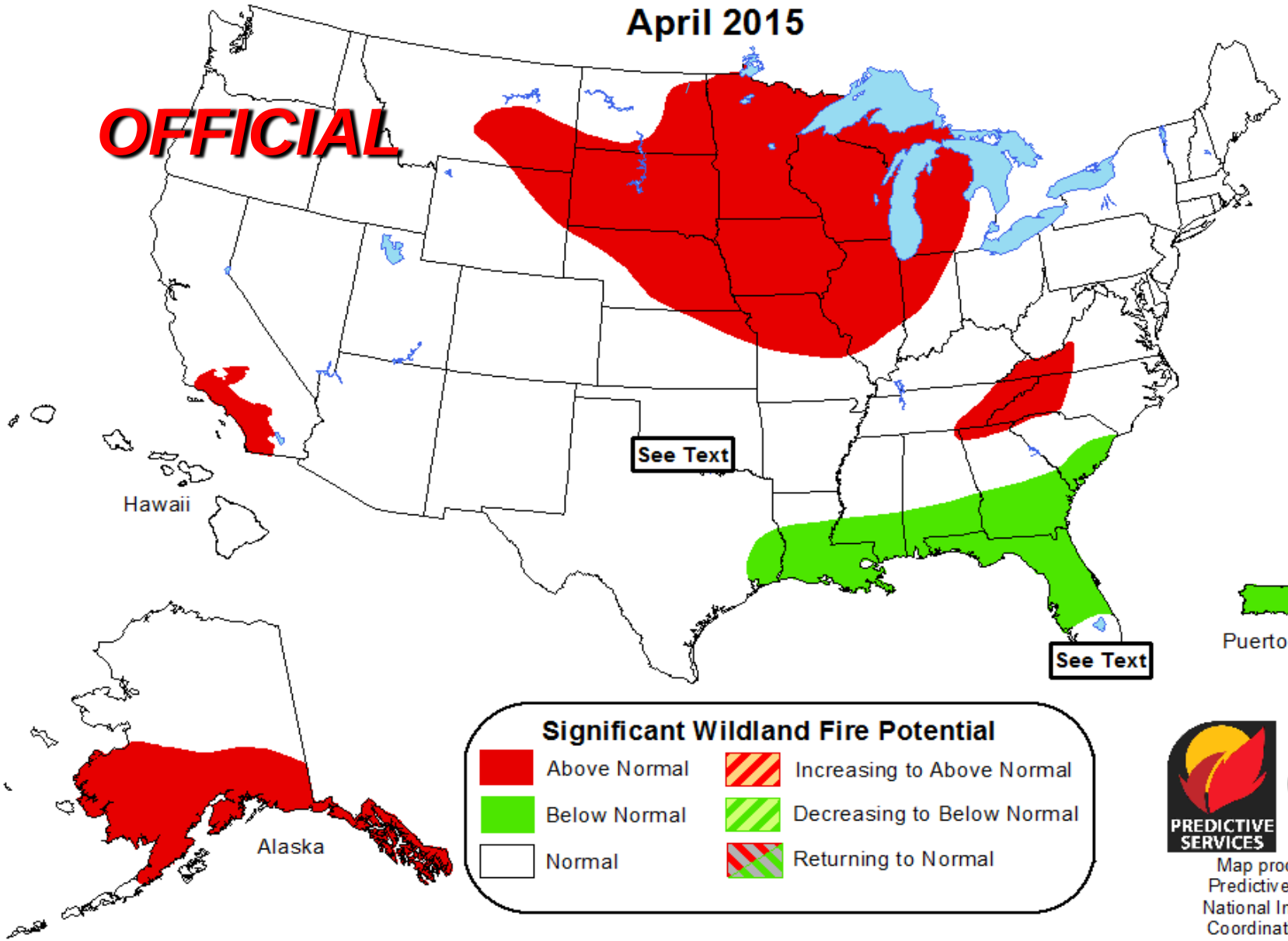


Other areas of concern: CA/OR/WA wrn NV and possibly AK.

- **The factors assessed thus far lead to a prediction of Above Normal PSAs 1/2/3/4/5/6 in July, spreading to PSAs 7/8/9/12 by August. With Normal PSAs 10/11 and 13 through 18.**

Significant Wildland Fire Potential Outlook
April 2015

OFFICIAL



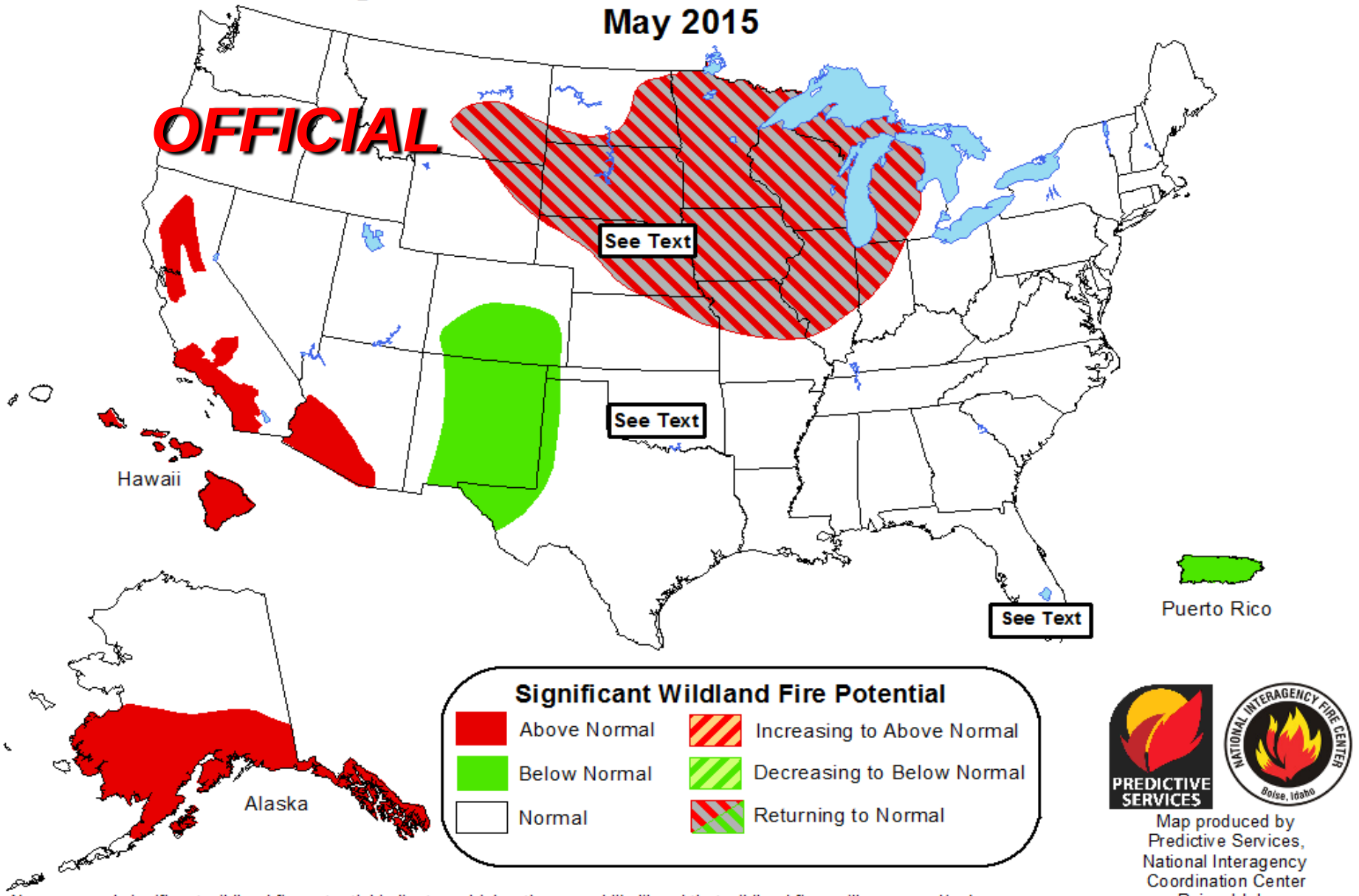
Significant Wildland Fire Potential

Above Normal	Increasing to Above Normal
Below Normal	Decreasing to Below Normal
Normal	Returning to Normal

Above normal significant wildland fire potential indicates a higher than usual likelihood that wildland fires will occur and/or become significant events. Wildland fires are still expected to occur during forecasted normal conditions as would usually be expected during the outlook period. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

Map produced by
Predictive Services,
National Interagency
Coordination Center
Boise, Idaho
Issued April 1, 2015
Next issuance May 1, 2015

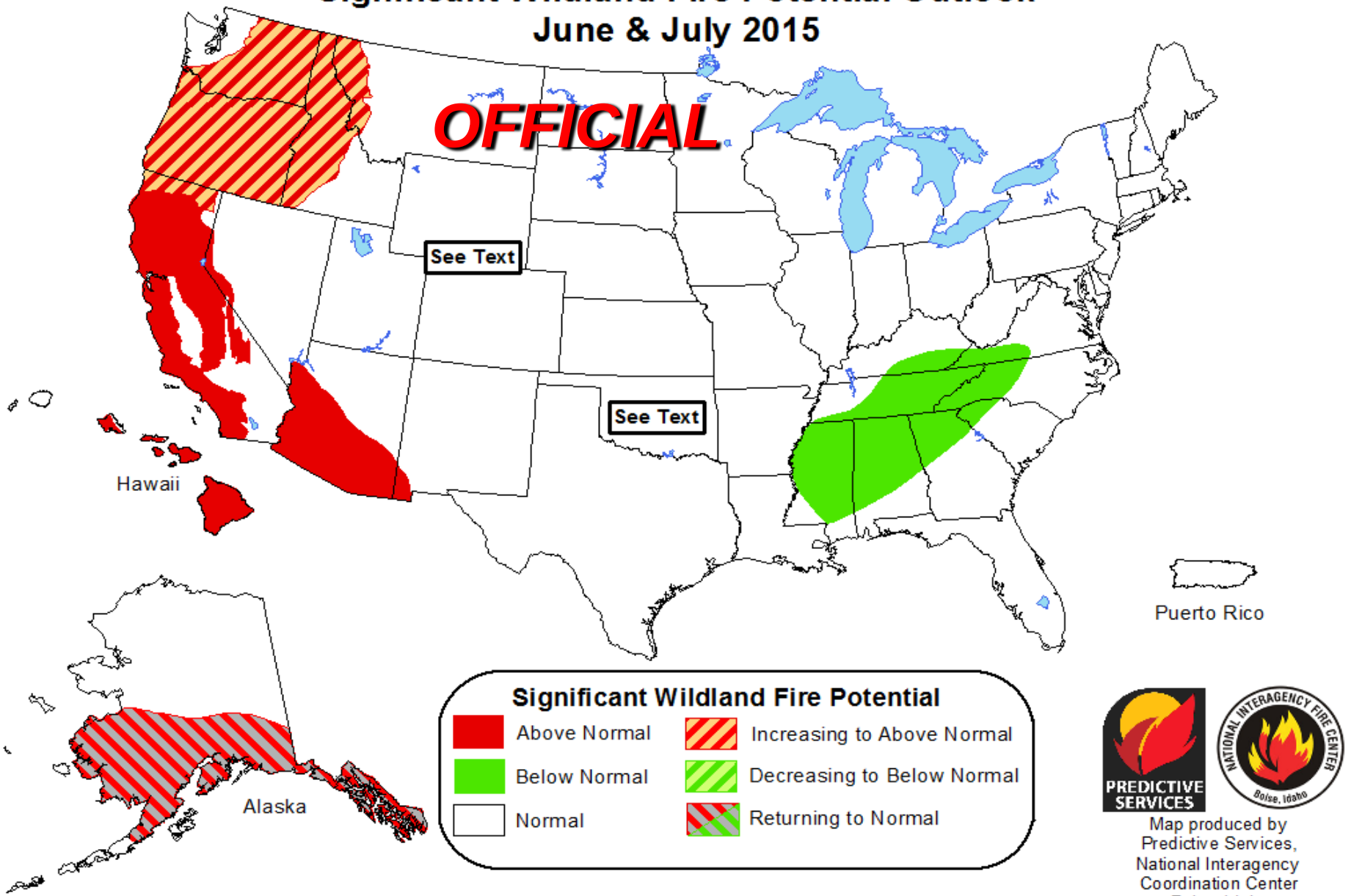
Significant Wildland Fire Potential Outlook
May 2015



Above normal significant wildland fire potential indicates a higher than usual likelihood that wildland fires will occur and/or become significant events. Wildland fires are still expected to occur during forecasted normal conditions as would usually be expected during the outlook period. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

Map produced by
Predictive Services,
National Interagency
Coordination Center
Boise, Idaho
Issued April 1, 2015
Next issuance May 1, 2015

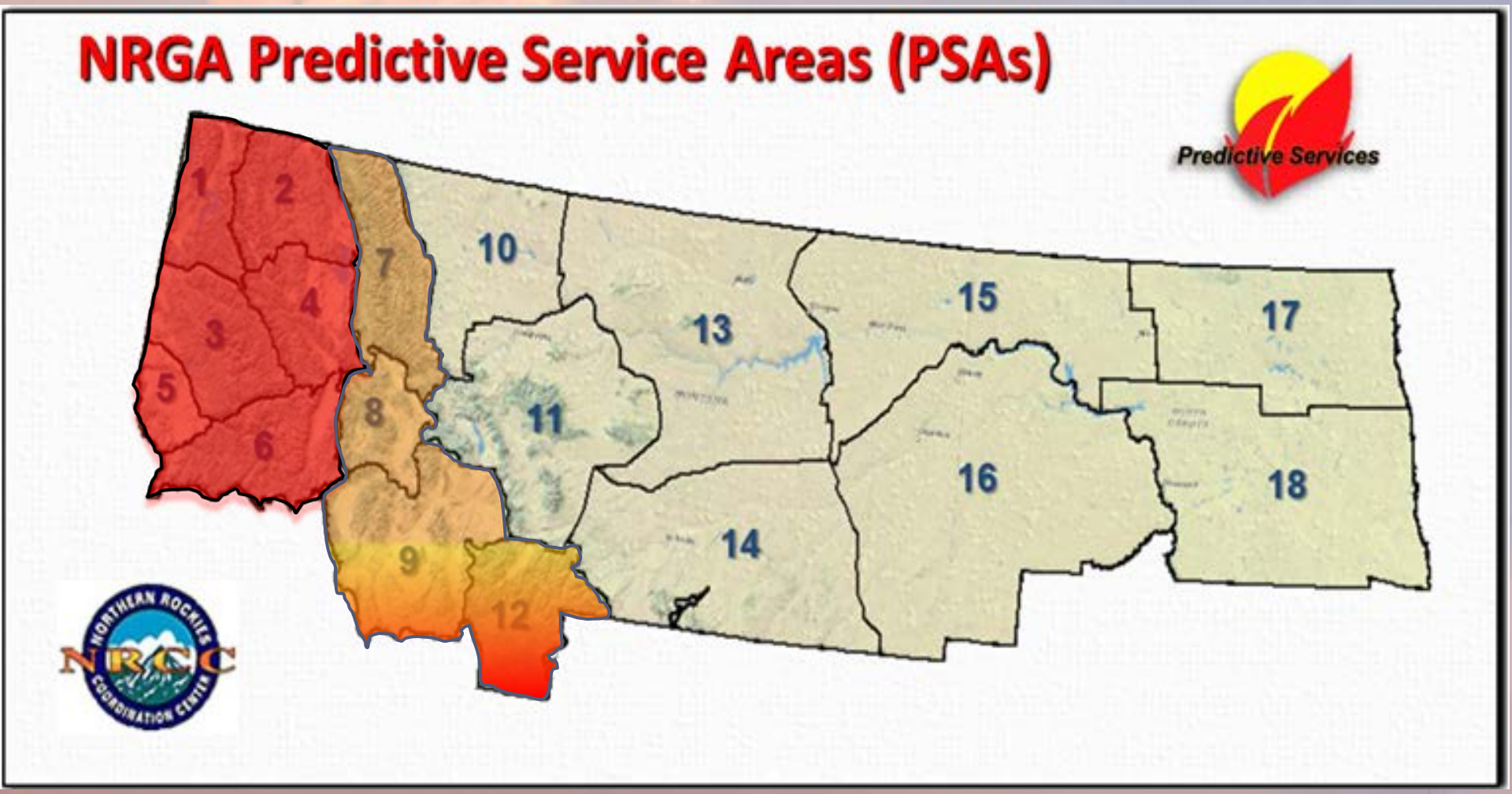
Significant Wildland Fire Potential Outlook
June & July 2015



Above normal significant wildland fire potential indicates a higher than usual likelihood that wildland fires will occur and/or become significant events. Wildland fires are still expected to occur during forecasted normal conditions as would usually be expected during the outlook period. Significant wildland fires are still possible but less likely than usual during forecasted below normal periods.

Map produced by
Predictive Services,
National Interagency
Coordination Center
Boise, Idaho
Issued April 1, 2015
Next issuance May 1, 2015

AUGUST



ABOVE NORMAL PSAs 1/2/3/4/5/6 Increasing to ABOVE NORMAL PSAs 7/8/9/12 – NORMAL PSAs 10 through 18.

Bass Creek Falls, Bitterroot Mtns. 5300 ft. 3/06/15

2015 Products and Services

http://gacc.nifc.gov/nrcc/

Bass Creek Falls, Bitterroot Mtns. 5300 ft. 4/11/15

Michael Richmond
(406)-329-4703
Michael_Richmond@fws.gov

Montana Water Supply and Moisture Status by County - October 2014

http://drought.mt.gov

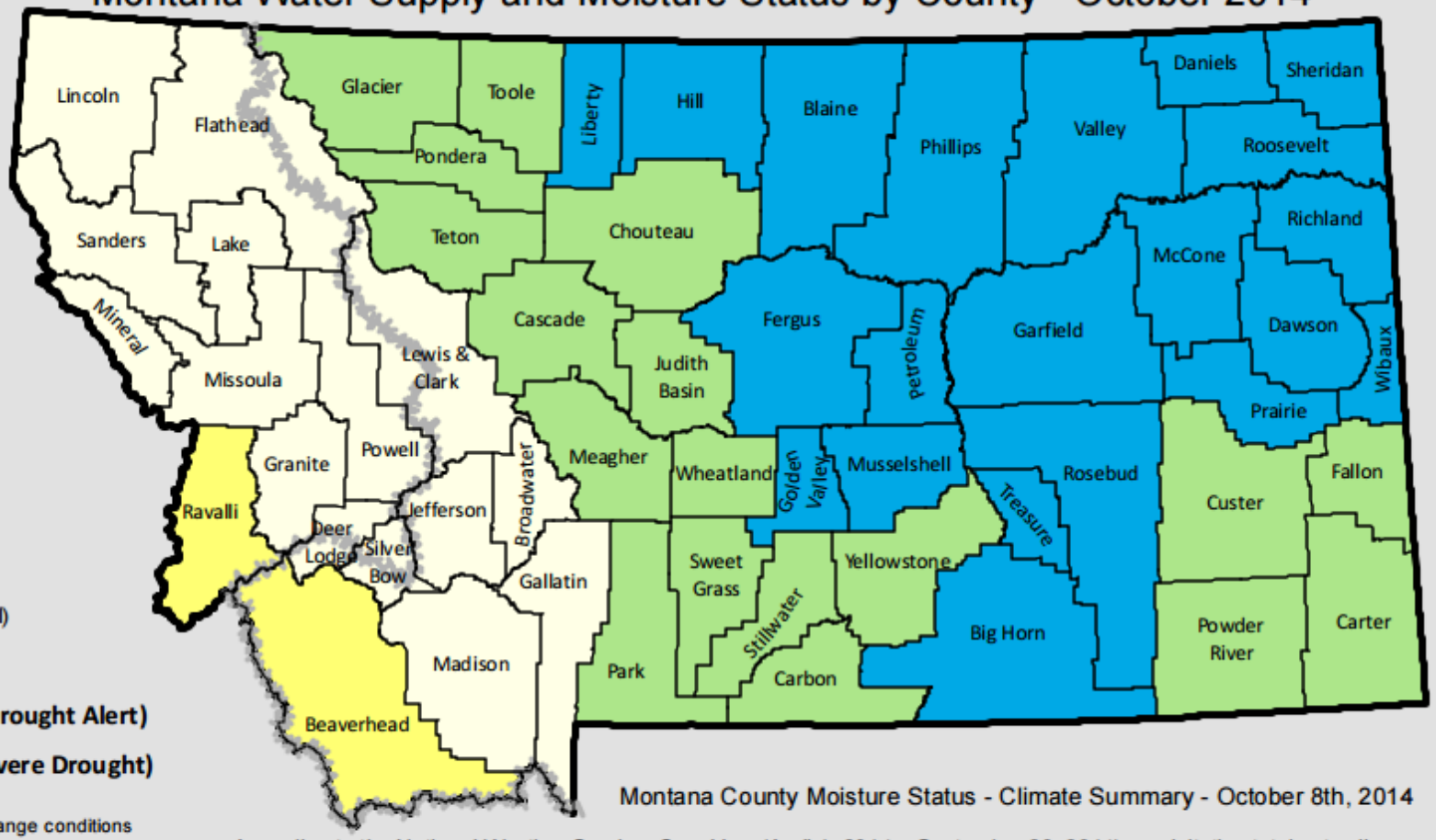
Map Key

Drought Impact Type

ContinentalDivide

Moisture Status

- Extremely Moist
- Moderately Moist
- Slightly Moist
- Near Average (Normal)
- Slightly Dry
- Moderately Dry **(Drought Alert)**
- Extremely Dry **(Severe Drought)**



Drought Impact Types -

A = Agricultural - Soil Moisture, Range conditions

H = Hydrological - Water Supplies, Streamflow, Groundwater

Drought Alert - Governor's Drought Advisory Committee strongly encourages local officials to convene local drought committees.

Severe Drought - Local officials should have local drought planning efforts underway or should reconvene the local drought committee at the earliest opportunity.
For recommended responses, see the Montana Drought Plan

Montana County Moisture Status - Climate Summary - October 8th, 2014

According to the National Weather Service, Crop Year (April 1, 2014 – September 28, 2014) precipitation totals at valley elevations ranged from about 100 - to 110-percent of normal for the southwest region; 75- to 100-percent for the western region; 130- to 150-percent for the northeastern region; 100- to 140-percent for the central region; 120- to 150 percent for the northcentral region; 100- to 120-percent for the southcentral region, and 110- to 130-percent for the southeast region, with exceptions in all seven regions of the state.

Flows in tributaries of the Yellowstone River Basin are rated as above to much above normal, the Missouri River basin, above to much above normal, and the Clark Fork River Basin, normal to above normal according to the USGS as of October 8, 2014: http://waterwatch.usgs.gov/new/index.php?id=ww_current

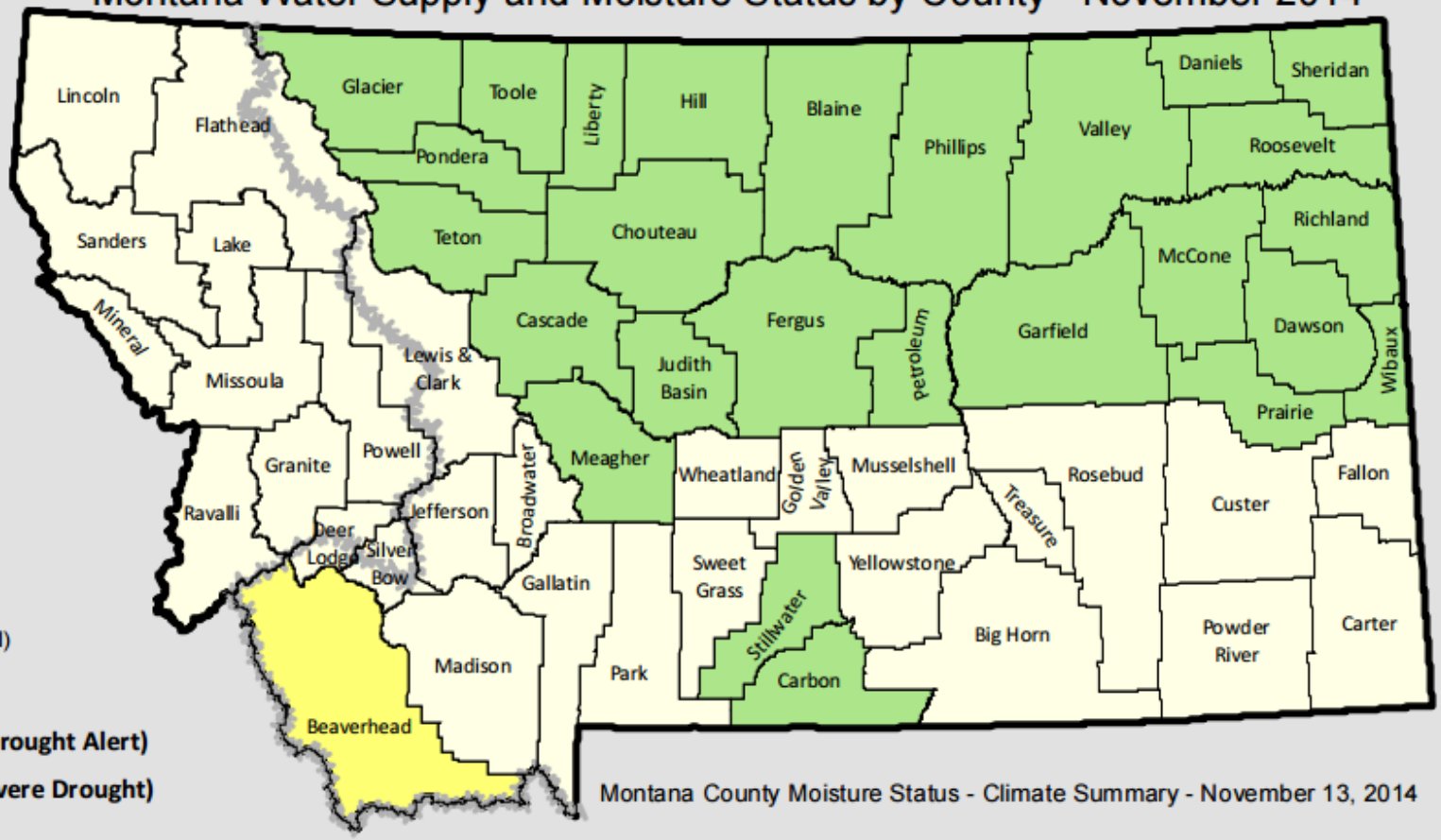
The October 1, 2014 NRCS Surface Water Supply Index (SWSI) map rates only three of 54 Montana river basins as below its Near Average legend category: The Beaverhead River basin in the headwaters of the Missouri River basin, and the North Fork of the Flathead River and Bitterroot River basins, both west of the Continental Divide and in the Clark Fork River basin, rated as Slightly Dry at this time:
http://ftp.geoinfo.msl.mt.gov/Documents/Maps/Collections/SurfaceWaterSupplyIndex/SWSI_201410_map.pdf

According to the week-ending October 5, 2014, USDA NASS Crop Progress report, "Range and pasture conditions were better than the 5-year average, with 53 percent rated as good to excellent, compared with 32 percent respectively. Producers continued moving livestock off of summer ranges after a wintery storm mid-week. Cattle are being moved below the five-year average pace, with 40 percent moved. Range and pasture feed condition was rated as 53 percent good to

Montana Water Supply and Moisture Status by County - November 2014

MONTANA DNRC

http://drought.mt.gov



Map Key

Drought Impact Type

ContinentalDivide

Moisture Status

Current Month

- Extremely Moist
- Moderately Moist
- Slightly Moist
- Near Average (Normal)
- Slightly Dry
- Moderately Dry **(Drought Alert)**
- Extremely Dry **(Severe Drought)**

Drought Impact Types -

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Severe Drought - Local officials should have local drought planning efforts underway or should reconvene the local drought committee at the earliest opportunity.
For recommended responses, see the Montana Drought Plan

MONTANA State Library Geographic Information

http://apps.msl.mt.gov/Geographic_Information/Maps/Drought

Montana County Moisture Status - Climate Summary - November 13, 2014

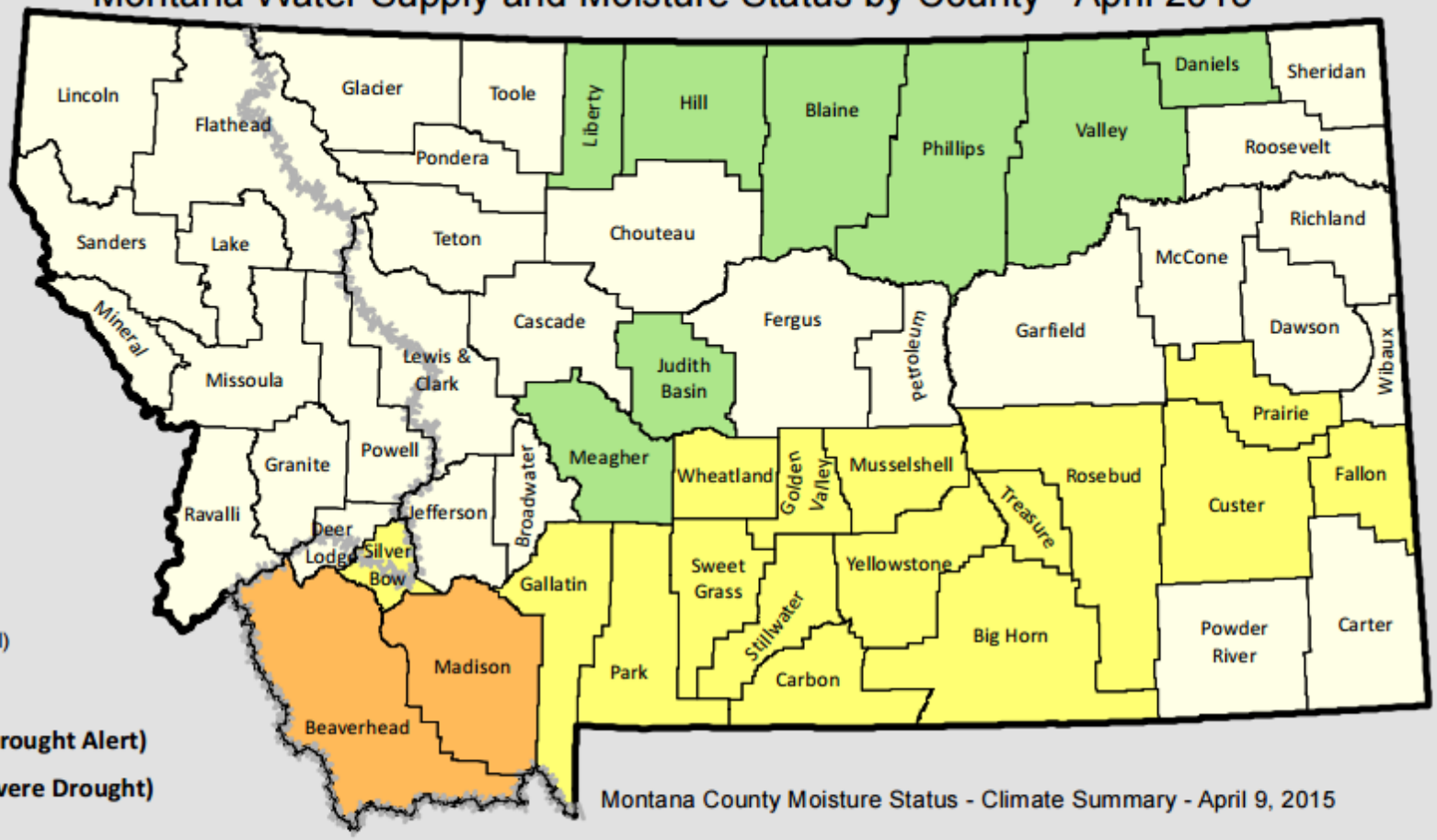
According to the National Weather Service, Water Year (October 1, 2014 – November 13, 2014) precipitation totals at valley elevations ranged from about 70 - to 90-percent of normal for the southwest region; 90- to 115-percent for the western region; 40- to 80-percent for the northeastern region; 50- to 70-percent for the central region; 90- to 150 percent for the northcentral region; 30- to 70-percent for the southcentral region, and 40- to 70-percent for the southeast region, with exceptions in all seven regions above.

Flows in the Yellowstone River Basin are rated as below normal to normal; the Missouri River basin, normal to much above normal, and the Clark Fork River Basin, below normal to above normal according to the USGS as of November 13, 2014:
http://waterwatch.usgs.gov/new/index.php?id=ww_current

The October 1, 2014 NRCS Surface Water Supply Index (SWSI) map rates only three of 54 Montana river basins as below its Near Average legend category: The Beaverhead River basin in the headwaters of the Missouri River basin, and the North Fork of the Flathead River and Bitterroot River basins, both west of the Continental Divide and in the Clark Fork River basin, rated as Slightly Dry at this time:
http://ftp.geoinfo.msl.mt.gov/Documents/Maps/Collections/SurfaceWaterSupplyIndex/SWSI_201410_map.pdf

According to the week-ending October 26, 2014, USDA NASS Crop Progress report, "Range and pasture conditions remain above last year and the 5-year average with 52 percent rated as good to excellent, compared with 49 and 33 percent respectively. Cattle are being moved slightly behind last year and the five-year average, with 72 percent moved, while sheep are being moved ahead of last year and the 5- year average with 85 percent moved. Supplemental feeding of livestock had begun with 14-percent of cattle and 27-percent of sheep being fed. Topsoil moisture rated adequate and surplus was 79 percent, compared with 75 percent last year and the 5-year average of 57 percent. Subsoil moisture was rated 81 percent adequate and surplus compared with 72 percent last year and the 5-year

Montana Water Supply and Moisture Status by County - April 2015



Montana County Moisture Status - Climate Summary - April 9, 2015

http://drought.mt.gov

Map Key

Drought Impact Type

ContinentalDivide

Moisture Status

Current Month

- Extremely Moist
- Moderately Moist
- Slightly Moist
- Near Average (Normal)
- Slightly Dry
- Moderately Dry **(Drought Alert)**
- Extremely Dry **(Severe Drought)**

Drought Impact Types -

A = Agricultural - Soil Moisture, Range conditions

H = Hydrological - Water Supplies, Streamflow, Groundwater

Drought Alert - Governor's Drought Advisory Committee strongly encourages local officials to convene local drought committees.

Severe Drought - Local officials should have local drought planning efforts underway or should reconvene the local drought committee at the earliest opportunity.
For recommended responses, see the Montana Drought Plan

According to the National Weather Service, Water Year to date (October 1, 2014 – April 9, 2015) precipitation totals at valley elevations ranged from about 60 - to 85-percent of normal for the **southwest** region; 125- to 140-percent for the **western** region; 65- to 120-percent for the **northeastern** region; 80- to 130-percent for the **central** region; 80- to 140 percent for the **northcentral** region; 60- to 80-percent for the **southcentral** region, and 60- to 80-percent for the **southeast** region, with exceptions in all seven regions of the state.

Flows in tributaries of the Yellowstone, and Missouri River Basins are rated as above normal with sections of the Clark Fork and the Lower Missouri basins as near record high flows according to the USGS as of April 9, 2015: http://waterwatch.usgs.gov/new/index.php?m=real&r=mt&w=map

Warmer than normal temperatures over the course of the past several weeks have had deleterious effects on low- to mid-elevation mountain snowpack with a premature period of snowmelt. The NRCS Snow Survey summary of mountain snowpack Snow Water Equivalent (SWE) of 15 major Montana river basins as of April 9, 2015 includes four (4) basins with less than 70 percent of median SWE and eleven (11) basins with percentages of median SWE between 70- and 90- percent. http://docs.msl.mt.gov/geoinfo/CurrentSWSI/Current_SWSI.pdf

The Montana Water Supply and Moisture Status by county map can be found here:

Clark Fork River Basin
Water Year(2015) Climate Summary & Outlook

By
Ray Nickless (Hydrologist)
National Weather Service in Missoula, MT

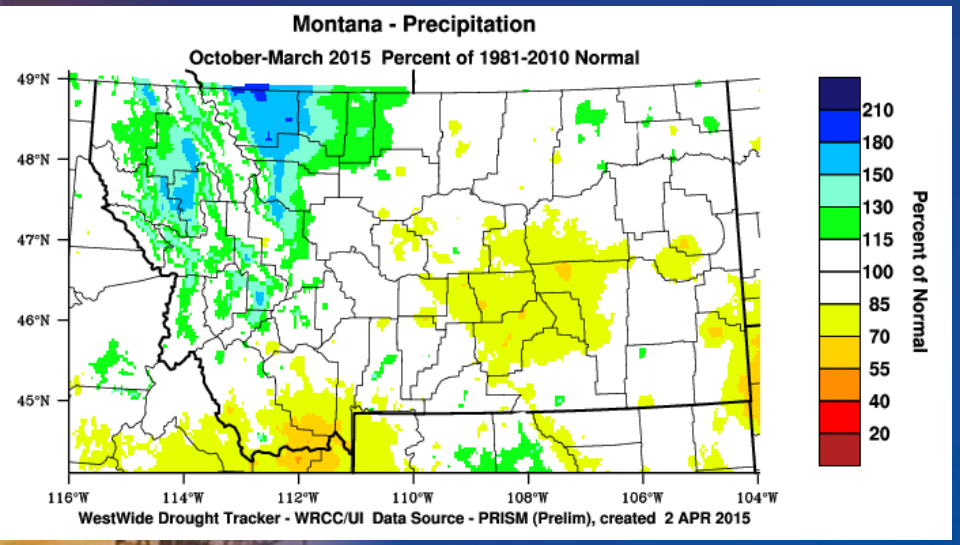
Overview

- Climate data for Water Year 2015
- Climate pattern through summer
- El Nino climate pattern

2015 – Water Year

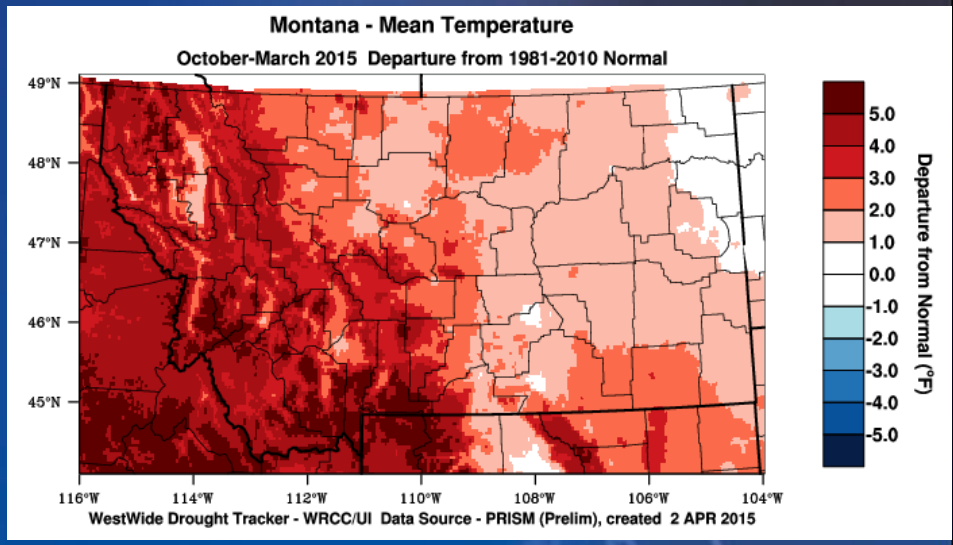
PRECIPITATION

October 2014 through March 2015



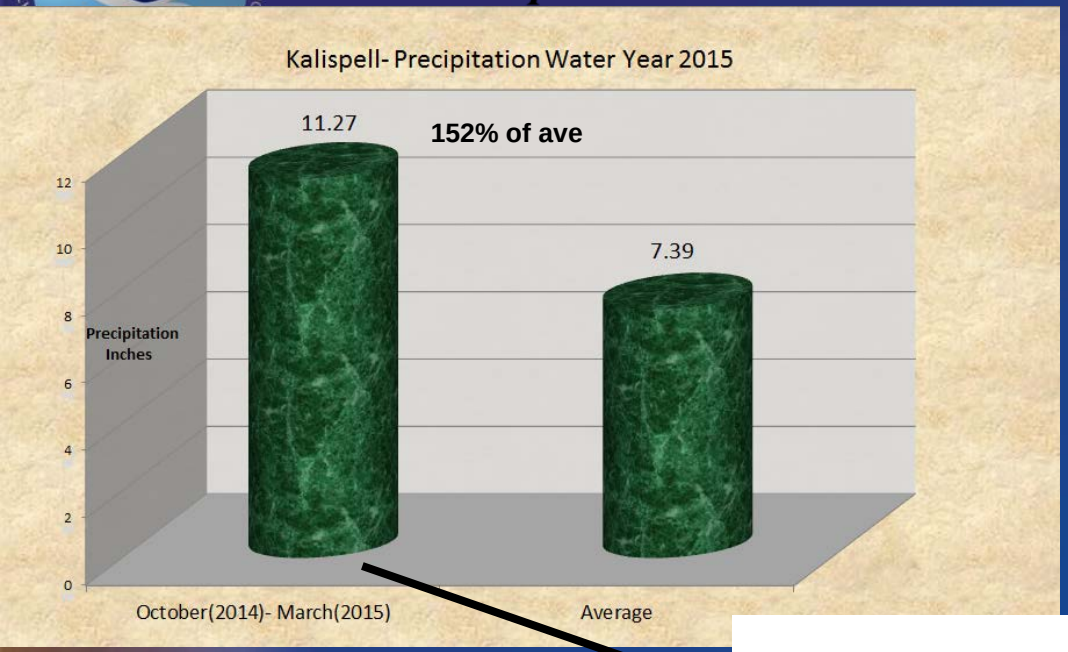
TEMPERATURES

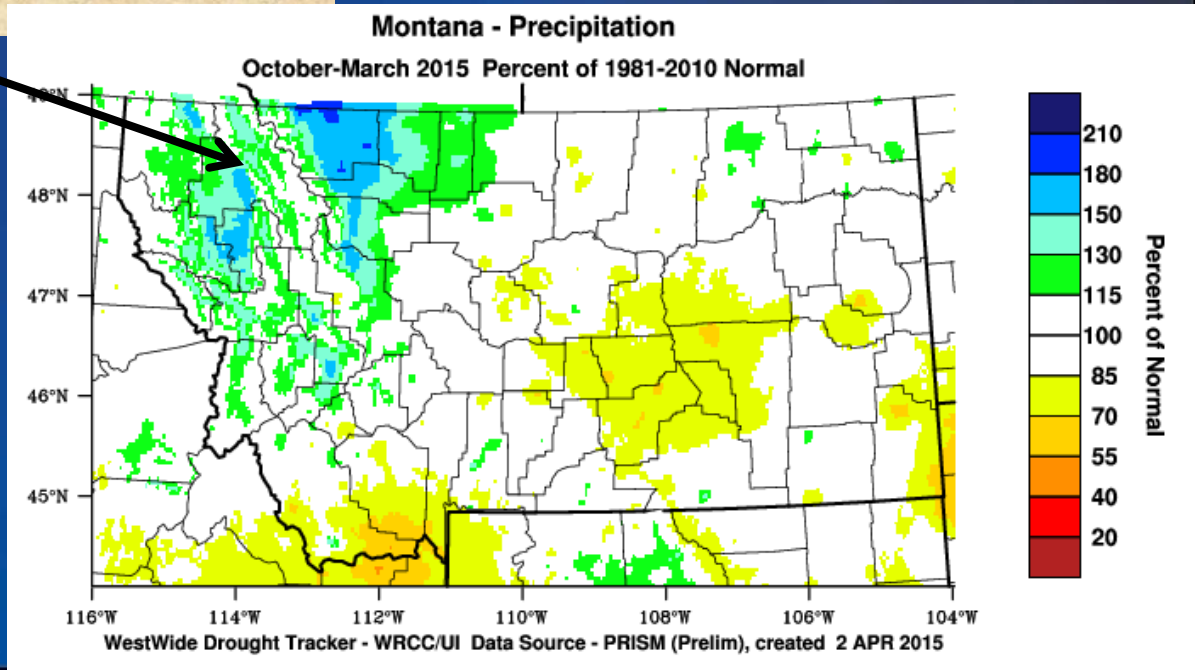
October 2014 through March 2015



Precipitation (October-March)

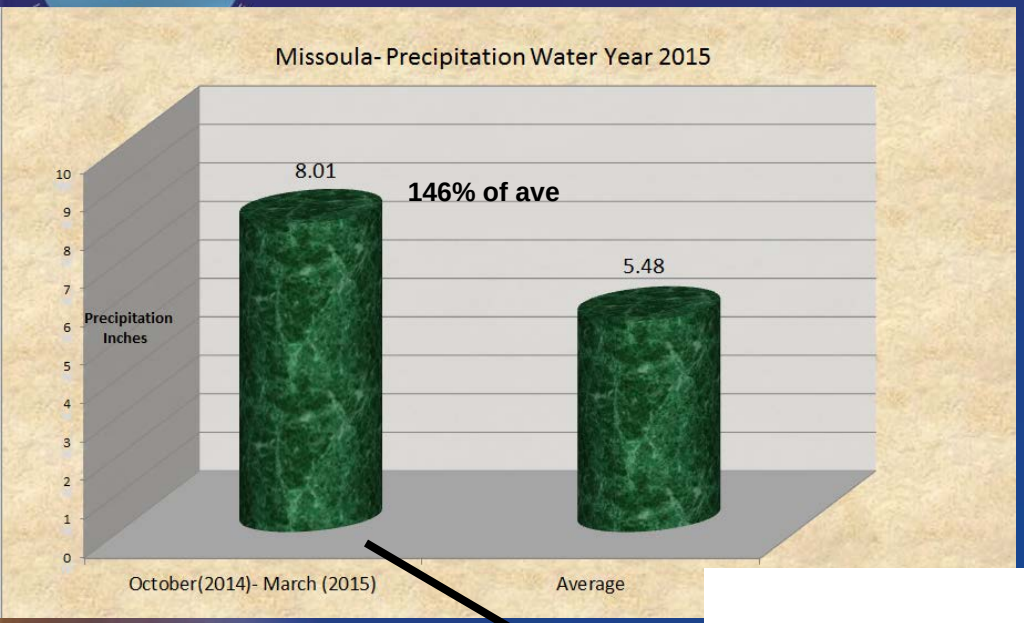
Kalispell

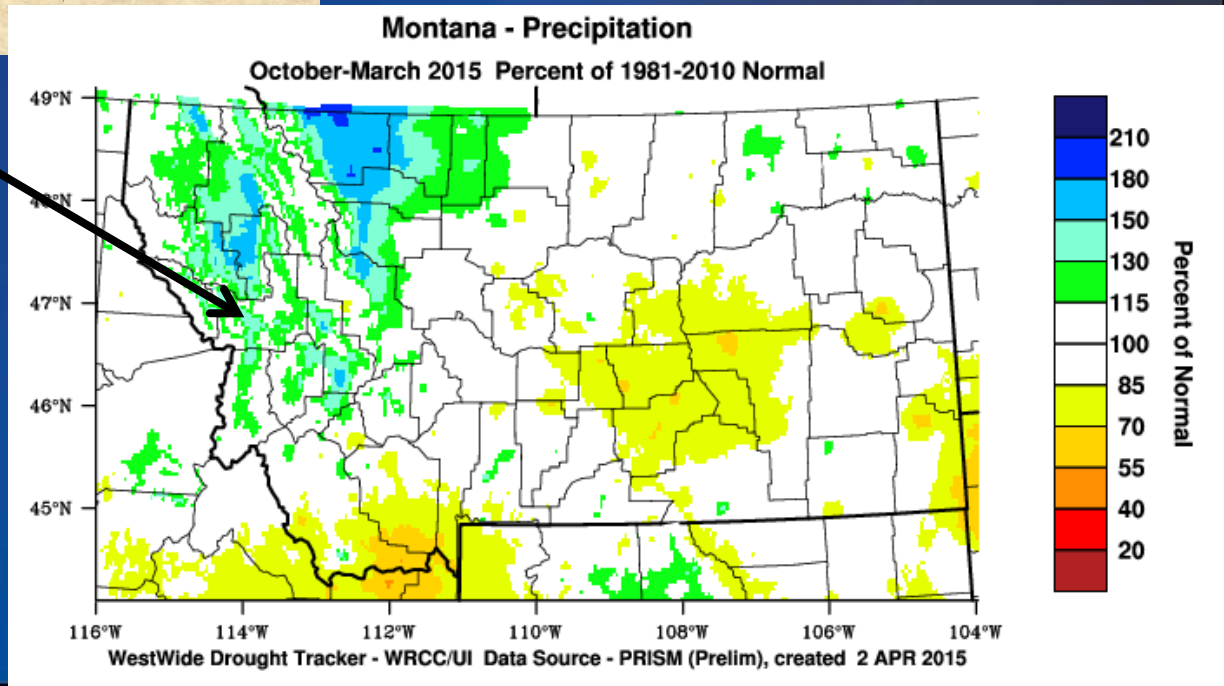




Precipitation (October-March)

Missoula

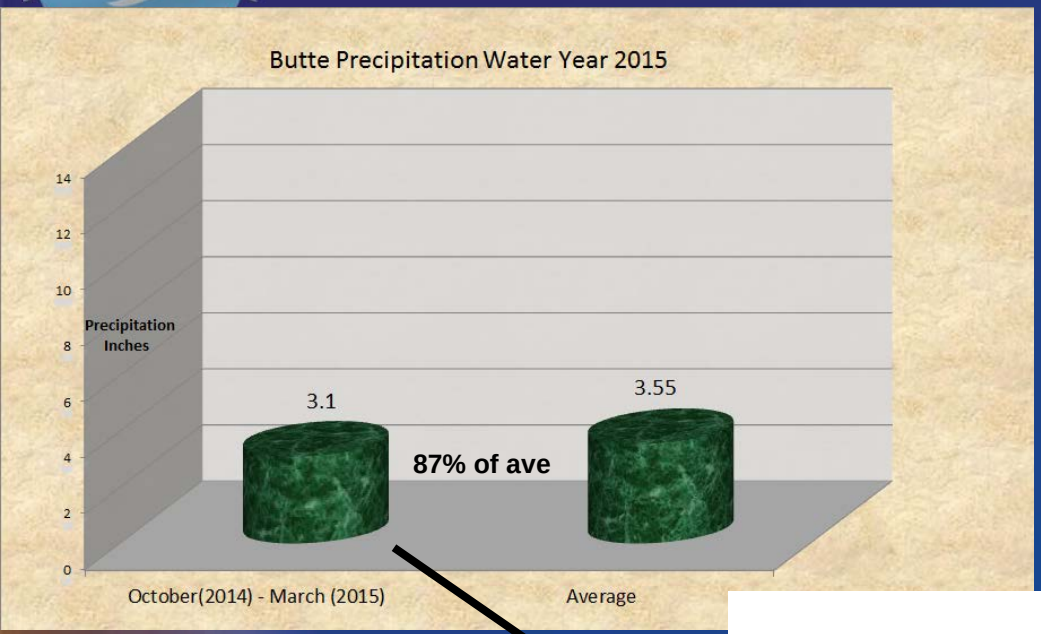


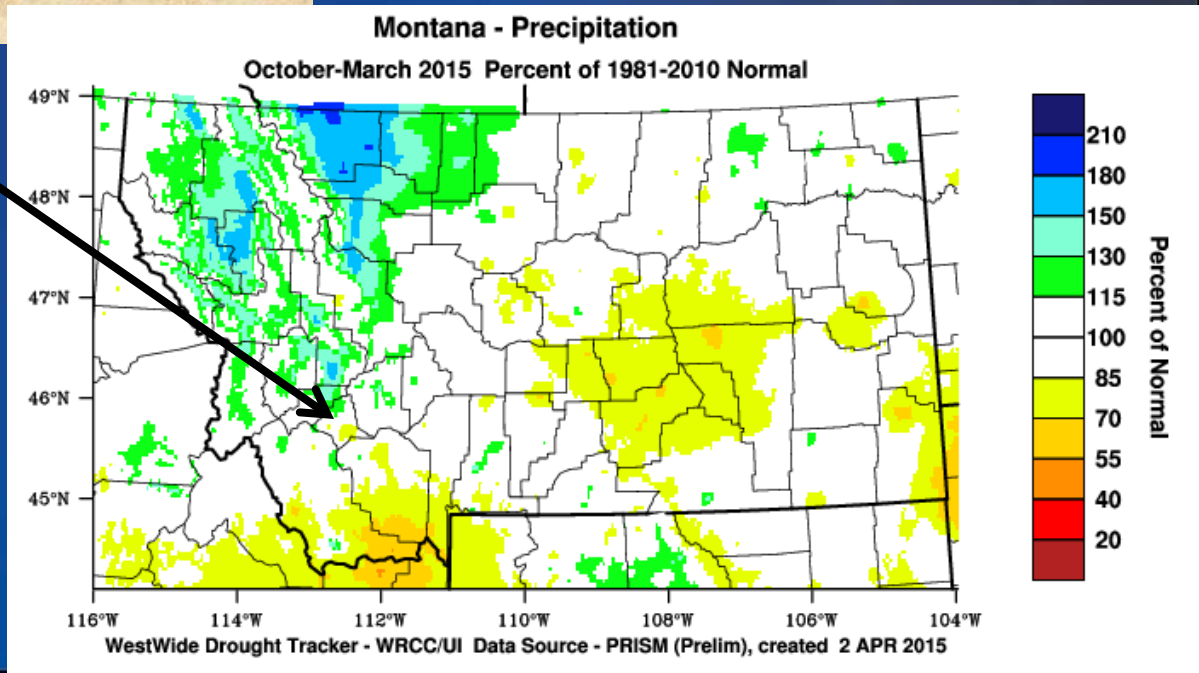


weather.gov

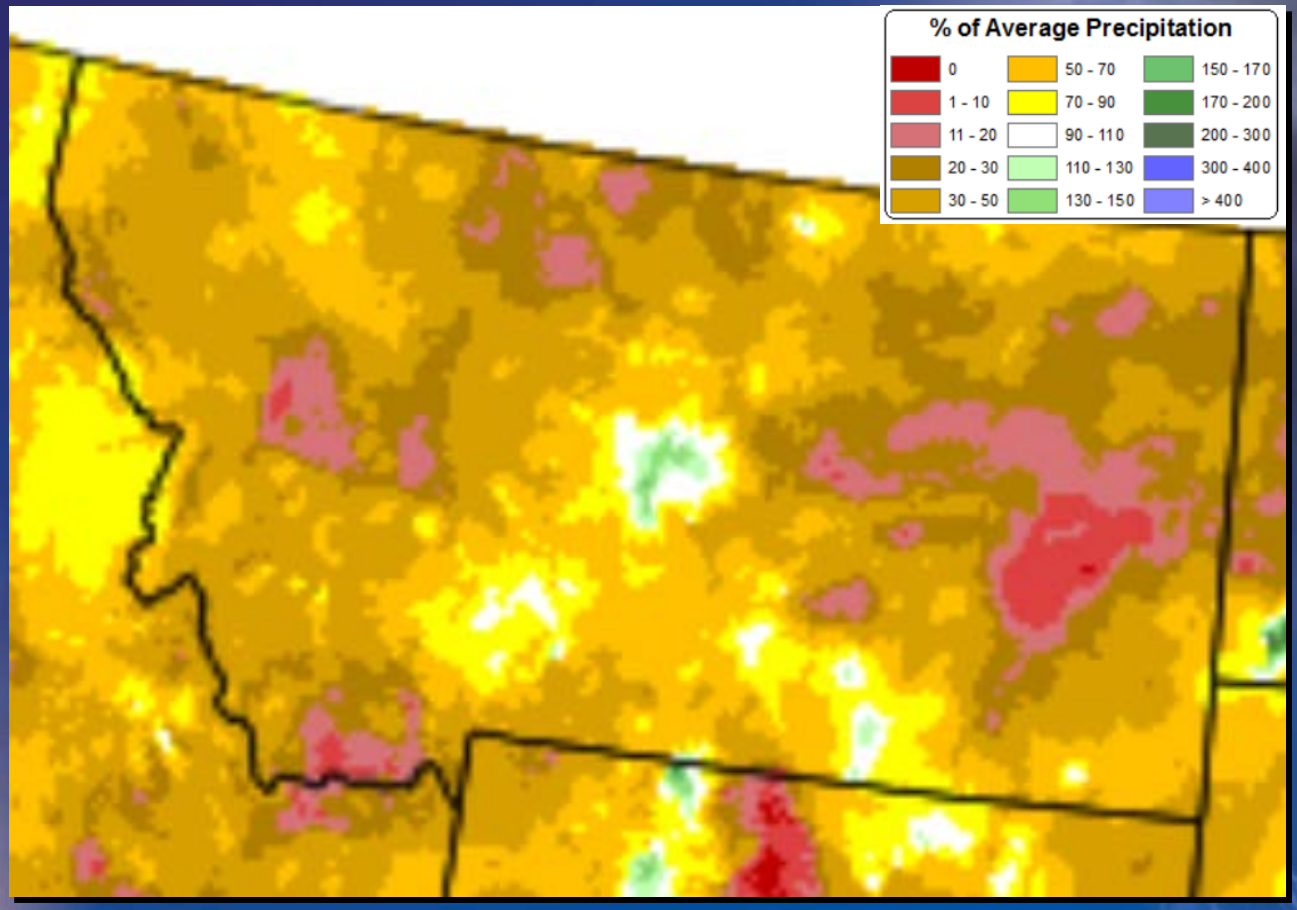
Precipitation (October-March)

Butte



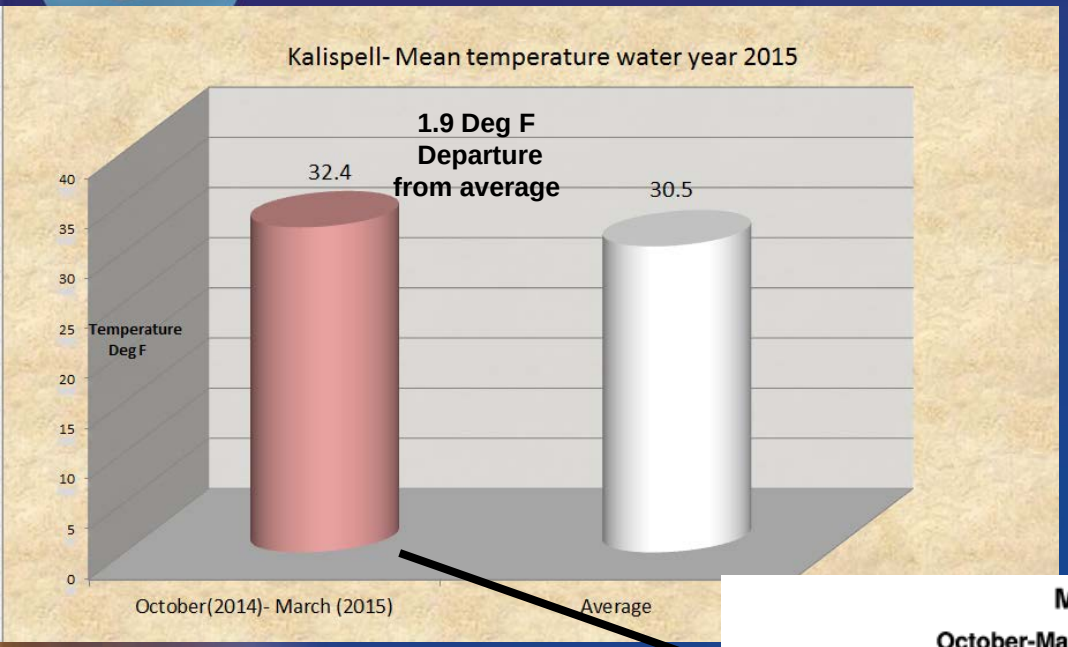


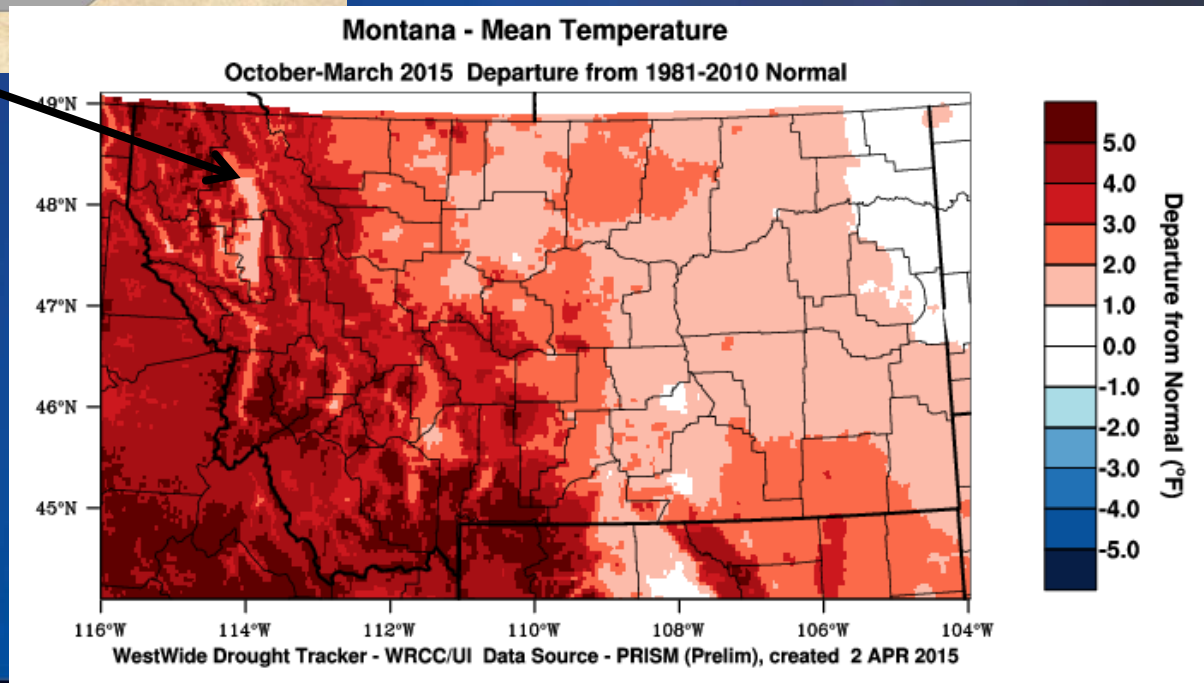
Precipitation (April 1st – 22nd 2015)



Temperature (October-March)

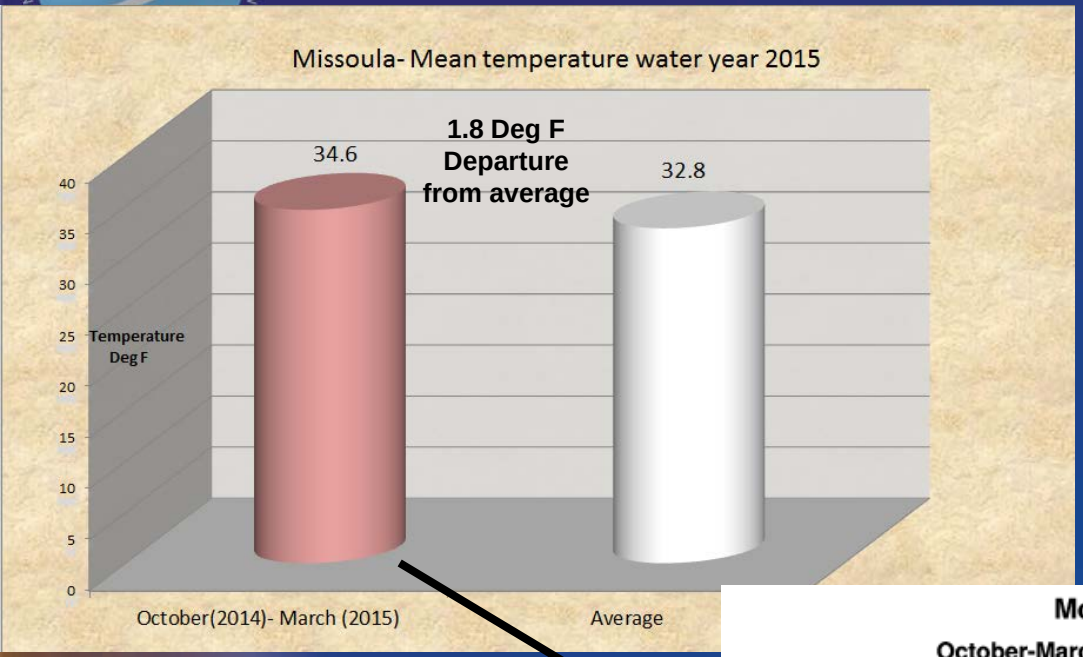
Kalispell

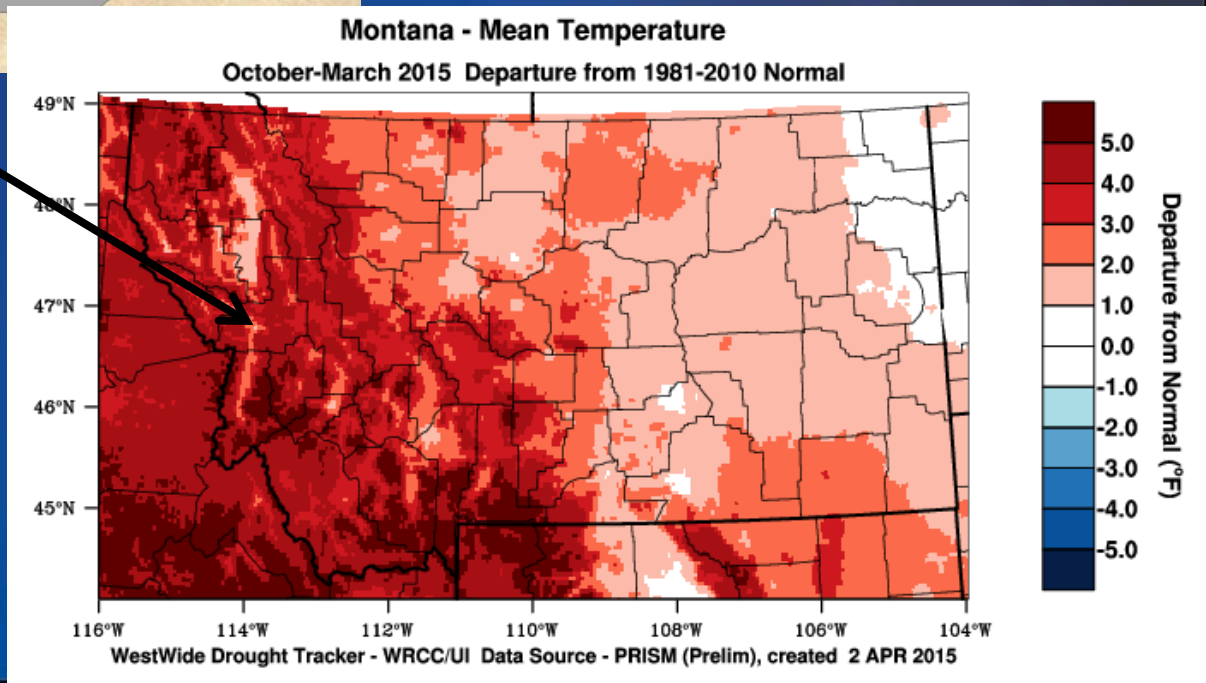




Temperature (October-March)

Missoula

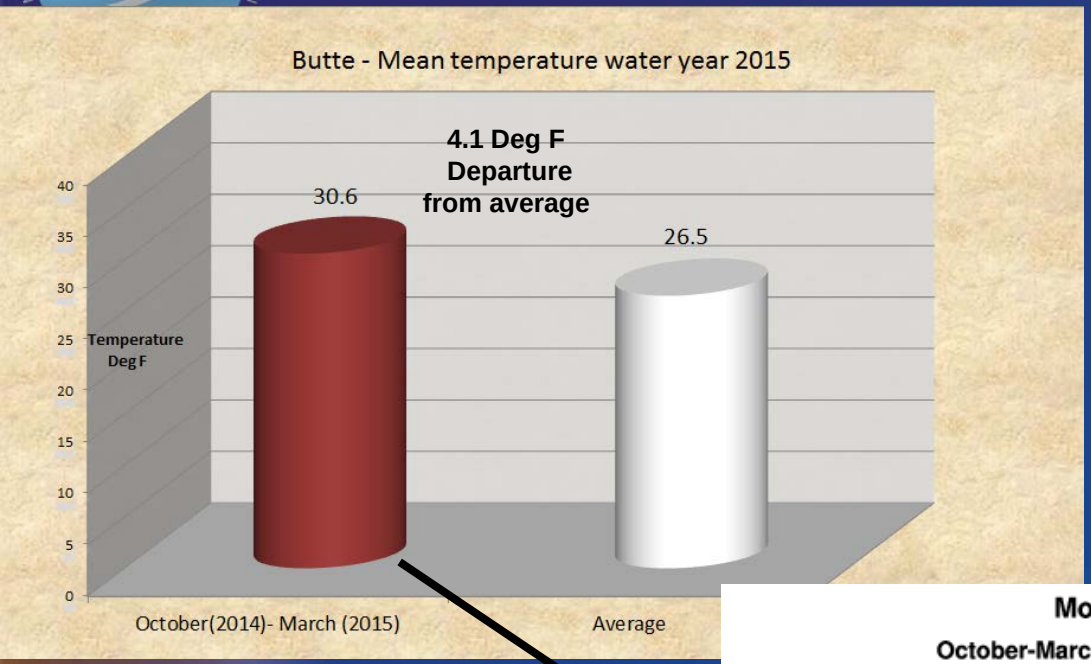


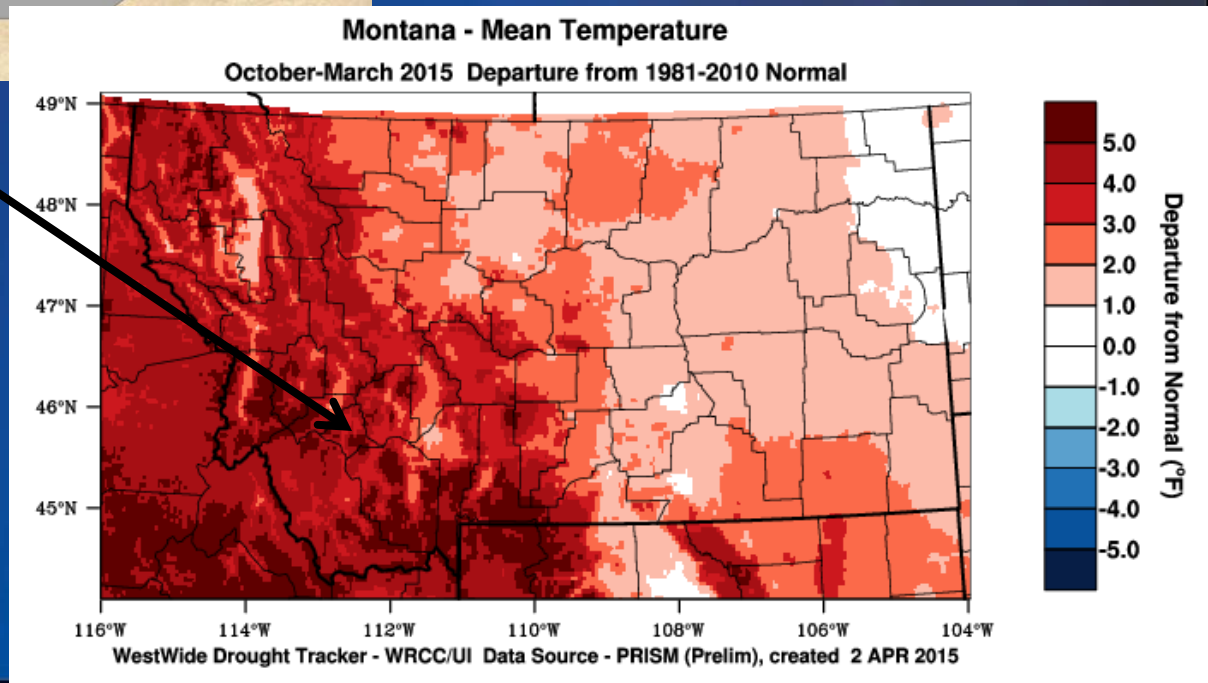


weather.gov

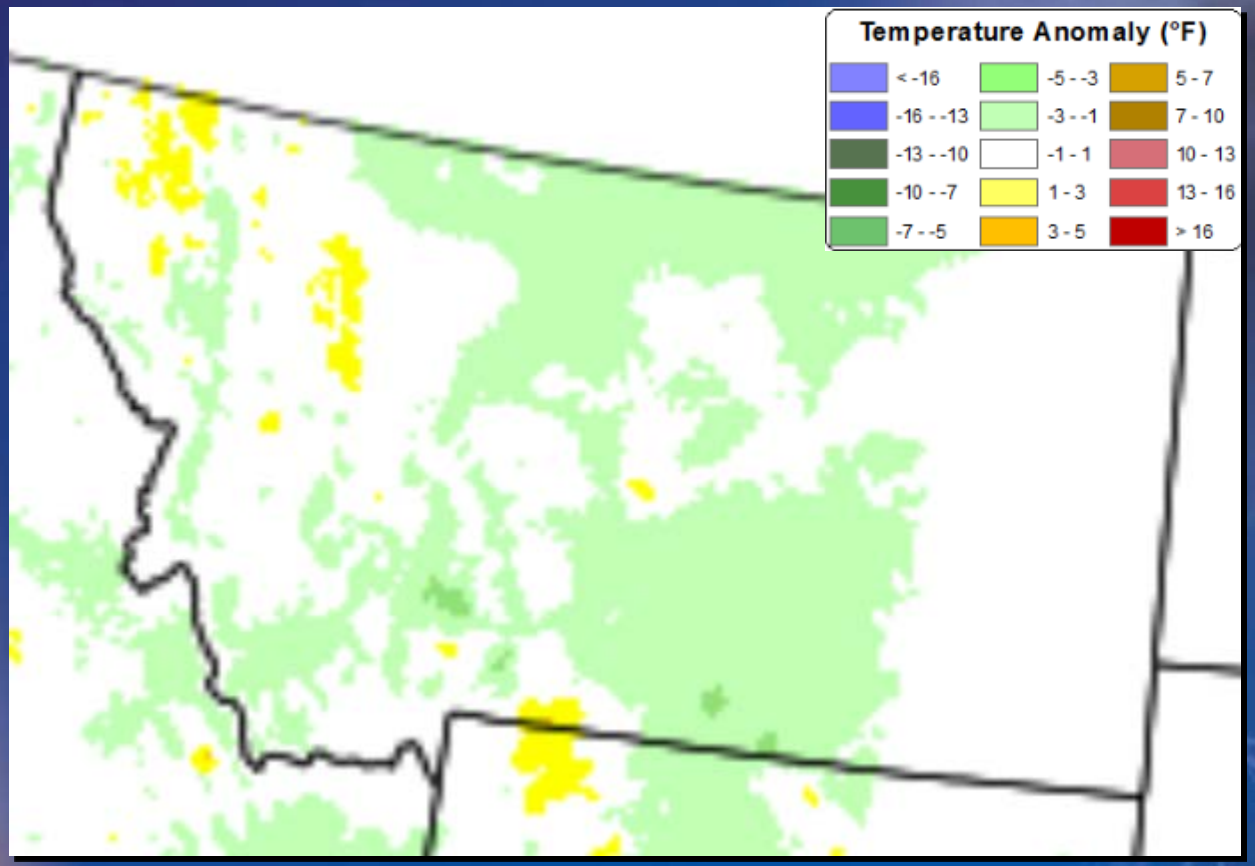
Temperature (October-March)

Butte





Temperature (April 1st – 22nd 2015)



Weather & Climate Outlook

Weather Outlook
Today through Weekend

Thursday	Thursday Night	Friday	Friday Night	Saturday	Saturday Night	Sunday
						
Mostly Sunny	Slight Chc Showers	Showers Likely	Mostly Cloudy	Chance Showers	Chance Showers	Chance Showers
High: 66 °F	Low: 35 °F	High: 58 °F	Low: 32 °F	High: 61 °F	Low: 34 °F	High: 57 °F

weather.gov

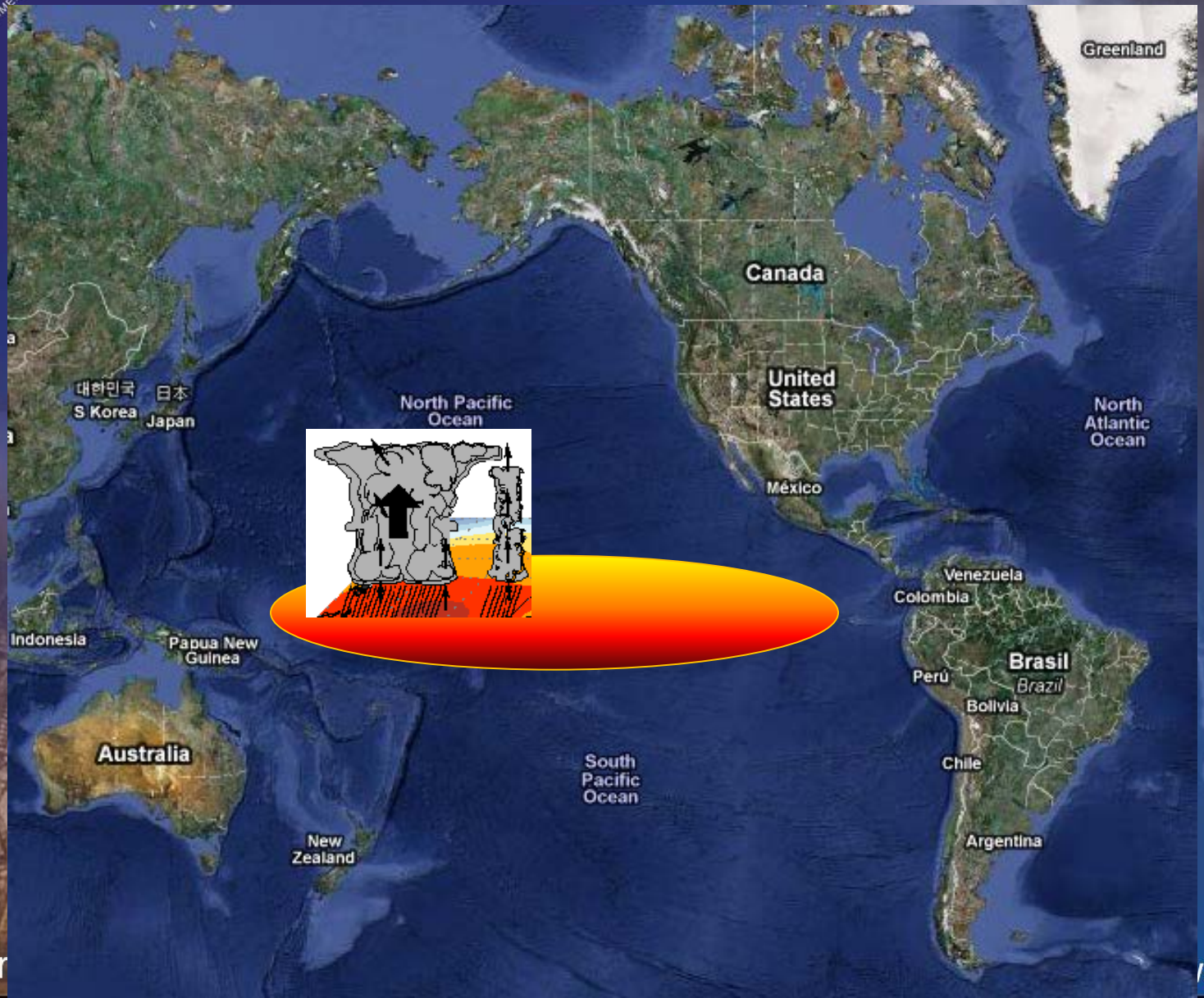
NOAA National Weather Service

Weather Outlook
Next week

Mostly
Sunny

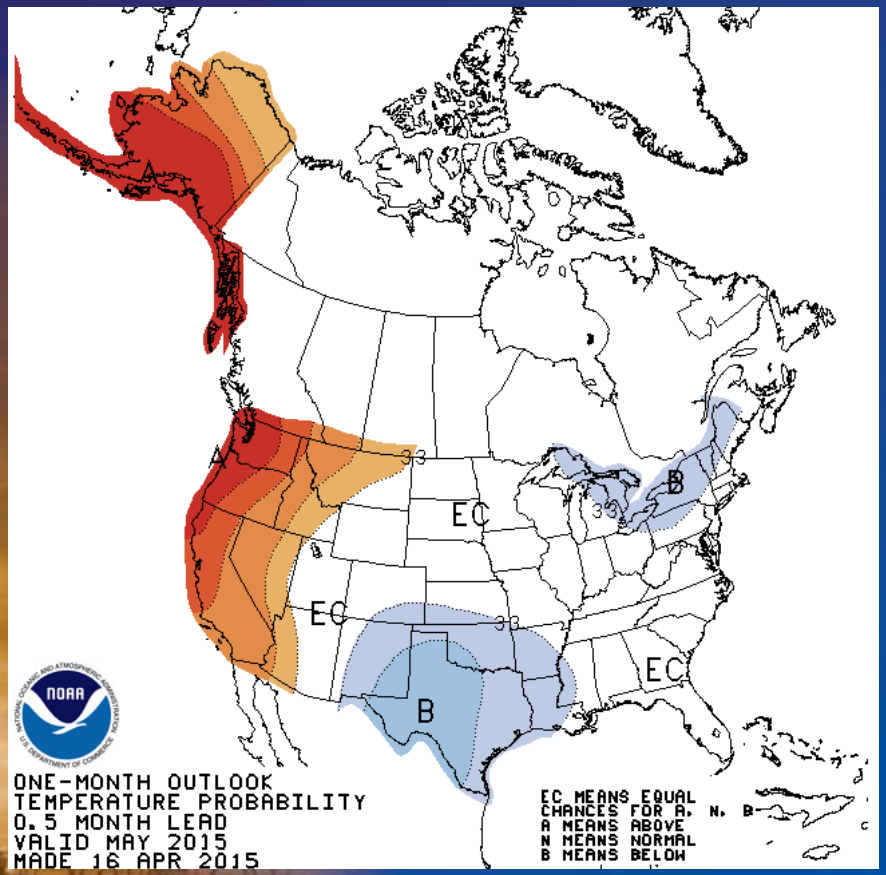
Monday	Partly sunny, with a high near 66.
Monday Night	Mostly cloudy, with a low around 35.
Tuesday	Mostly sunny, with a high near 73.
Tuesday Night	Partly cloudy, with a low around 37.
Wednesday	Mostly sunny, with a high near 82.

El Niño

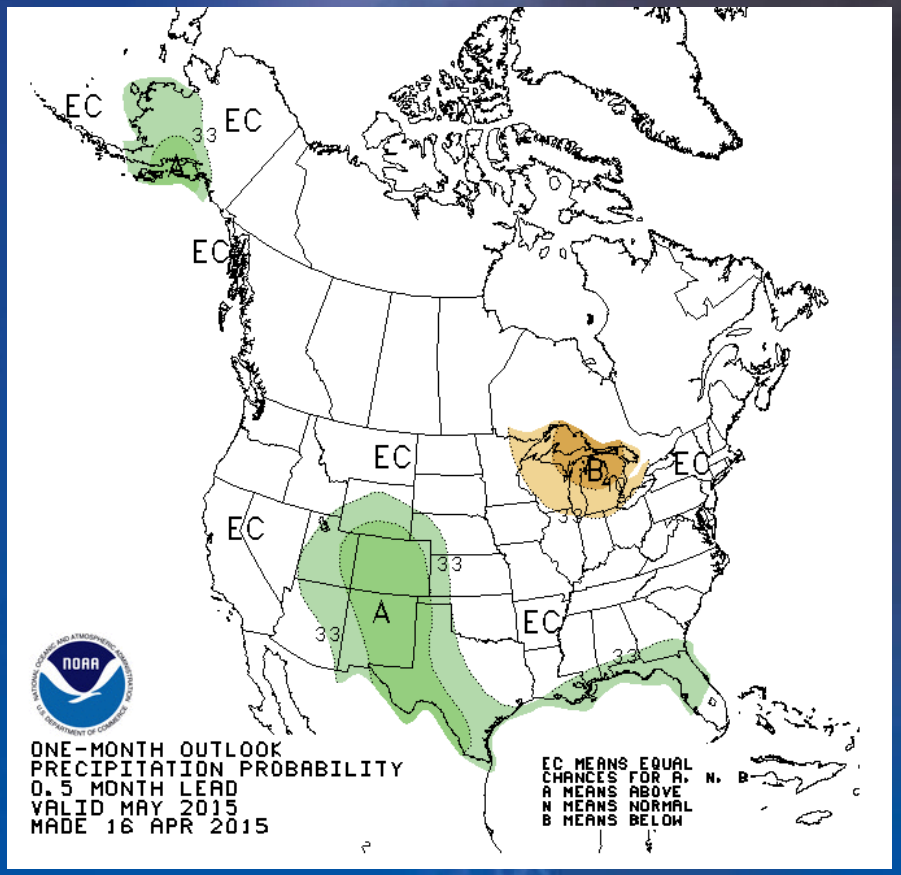

Greenland
Canada
United States
North Pacific Ocean
North Atlantic Ocean
México
대한민국
S Korea
日本
Japan
Indonesia
Papua New Guinea
Australia
New Zealand
South Pacific Ocean
Venezuela
Colombia
Brasil
Brazil
Perú
Bolivia
Chile
Argentina

Weather Outlook
May 2015

Temperature

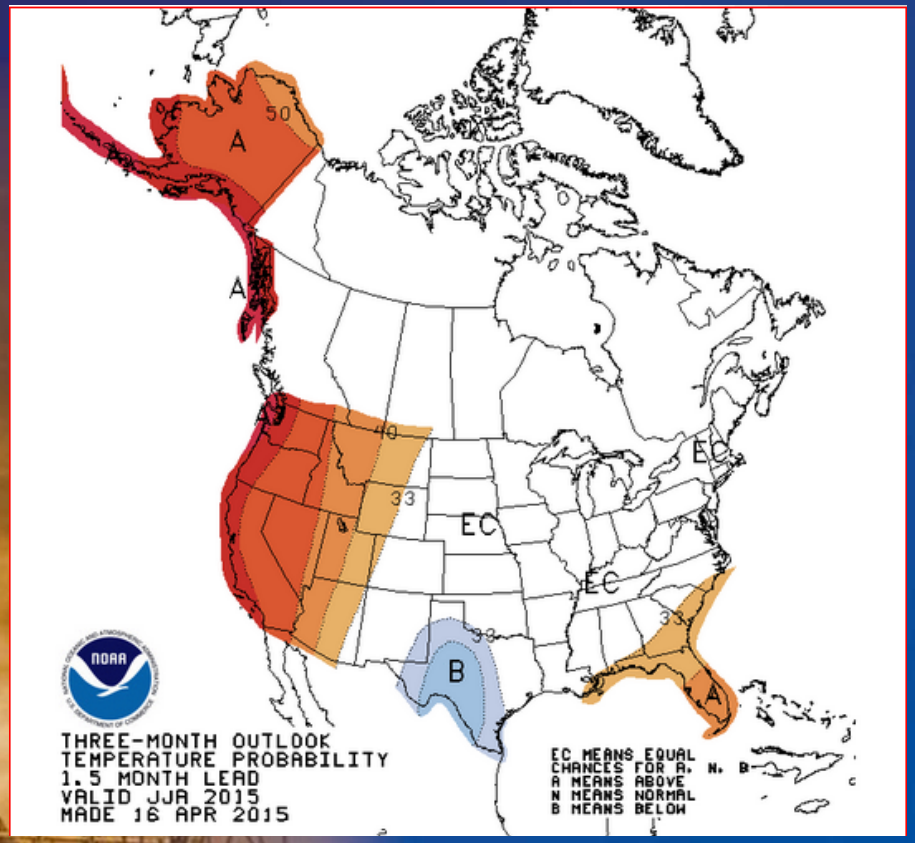


Precipitation

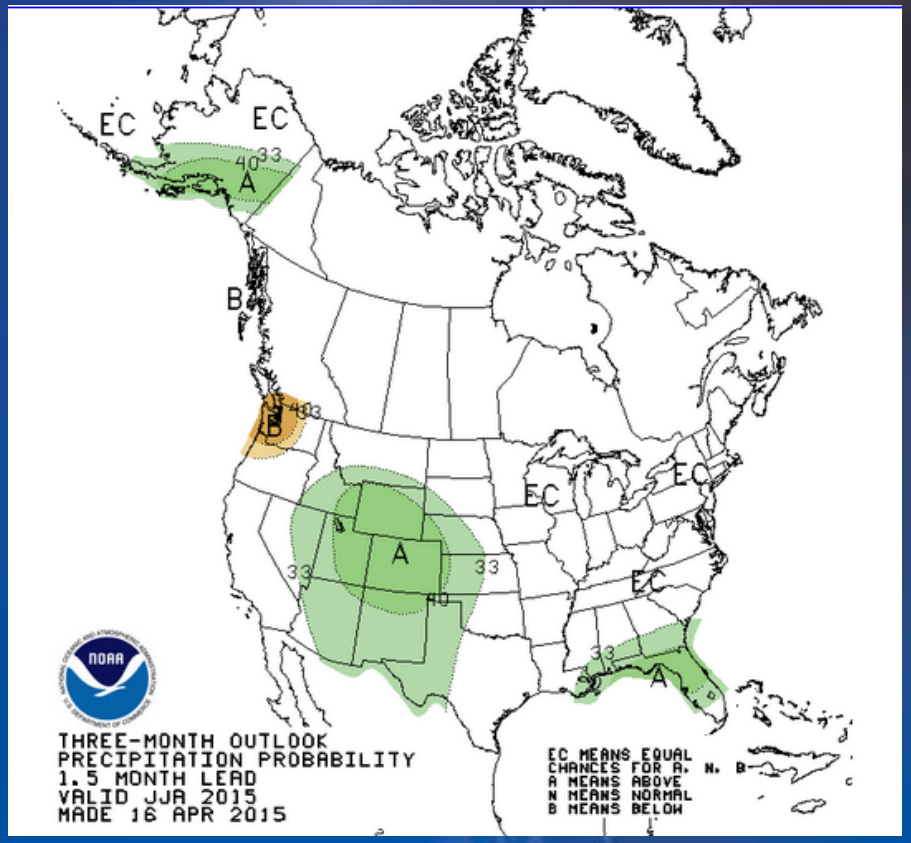


Weather Outlook
June-July-August 2015

Temperature

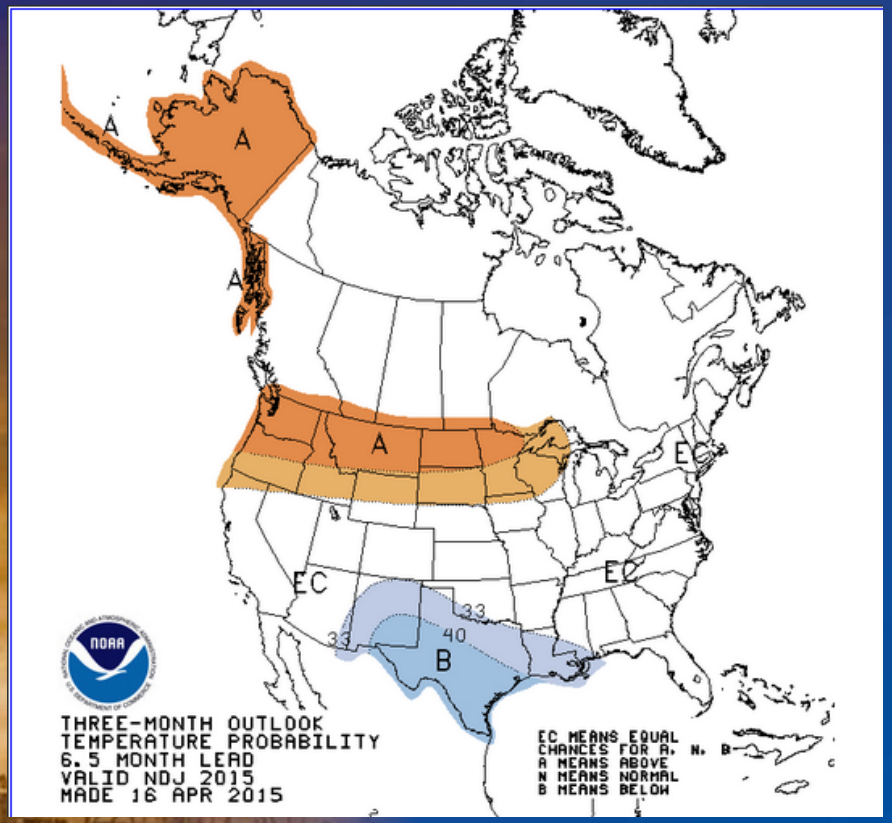


Precipitation

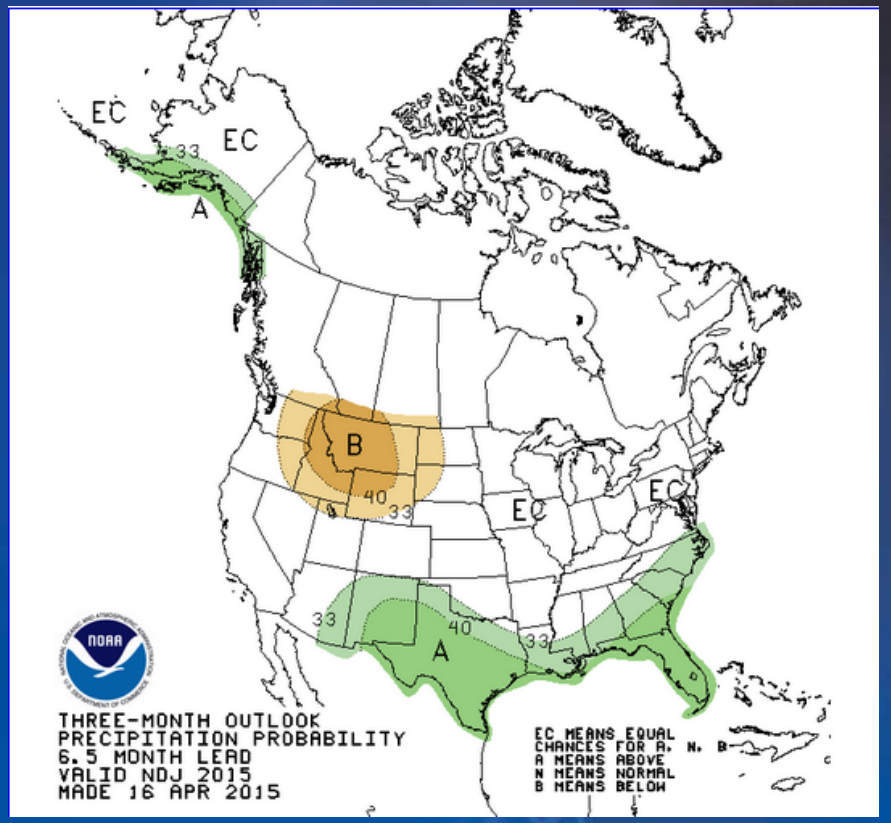


Weather Outlook
November-December-January 2015-2016

Temperature



Precipitation



Summary

- ***Water Year 2015 (October – March)***
  - Near Average Precipitation
  - Warmer Temperatures

- ***El Nino***
  - May influence weather this summer and next winter

- **For more details on weather & water forecasts**
  - ***Access NWS-Missoula Website***
    - http://www.wrh.noaa.gov/mso/
  - ***Contact***
    - National Weather Service Missoula, MT
    - Ph# 406-329-4840

West Side Water and Climate Workshop
Snowpack and Streamflow Update
April 23rd, 2015

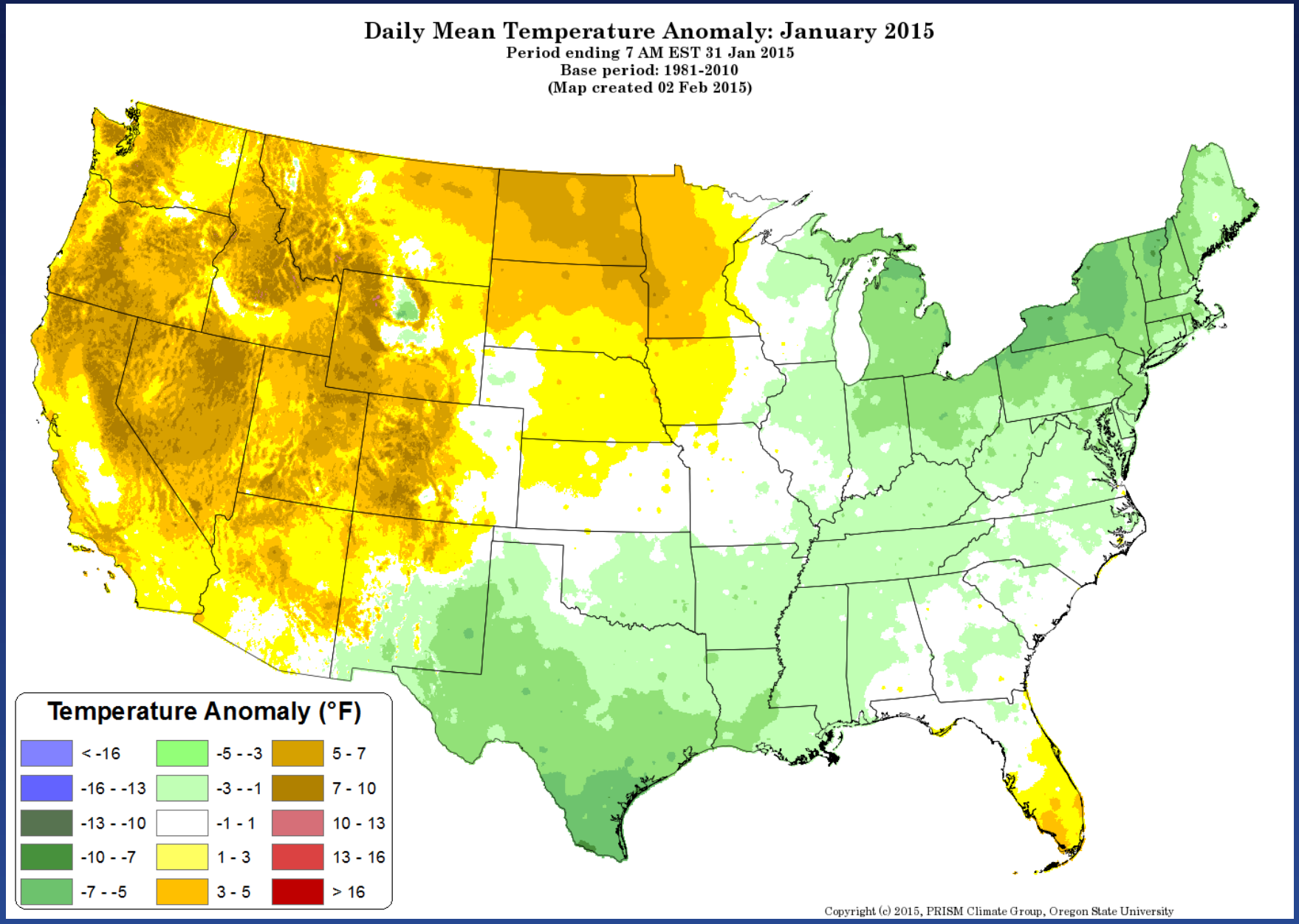
Lucas Zukiewicz
Water Supply Specialist (Snow Hydrologist)
USDA-NRCS
Montana Snow Surveys
Lucas.Zukiewicz@mt.usda.gov
406-587-6843

http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/

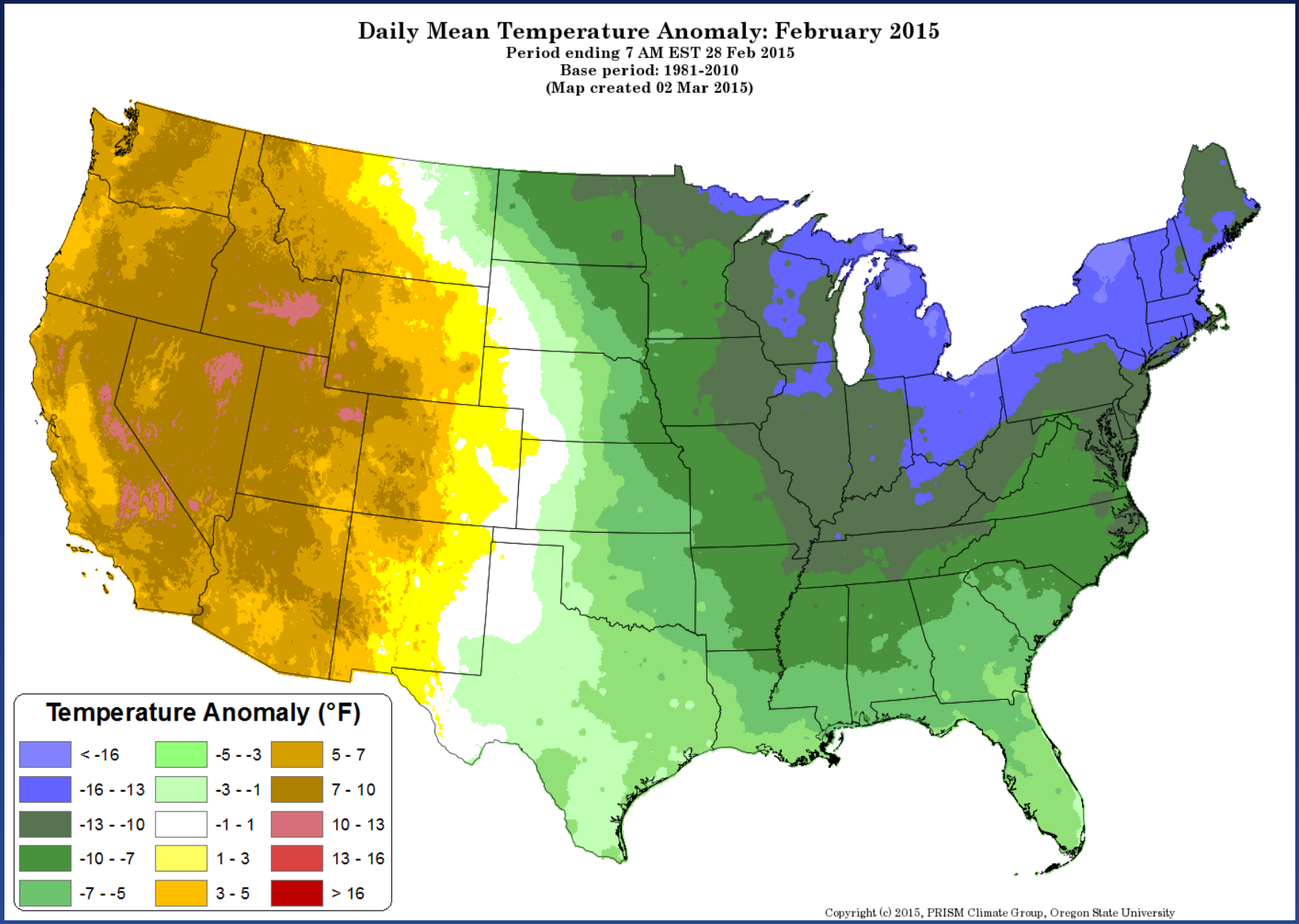
Yellowstone River near Corwin Springs, 1 day after peak flows, end of May 2014

Temperature

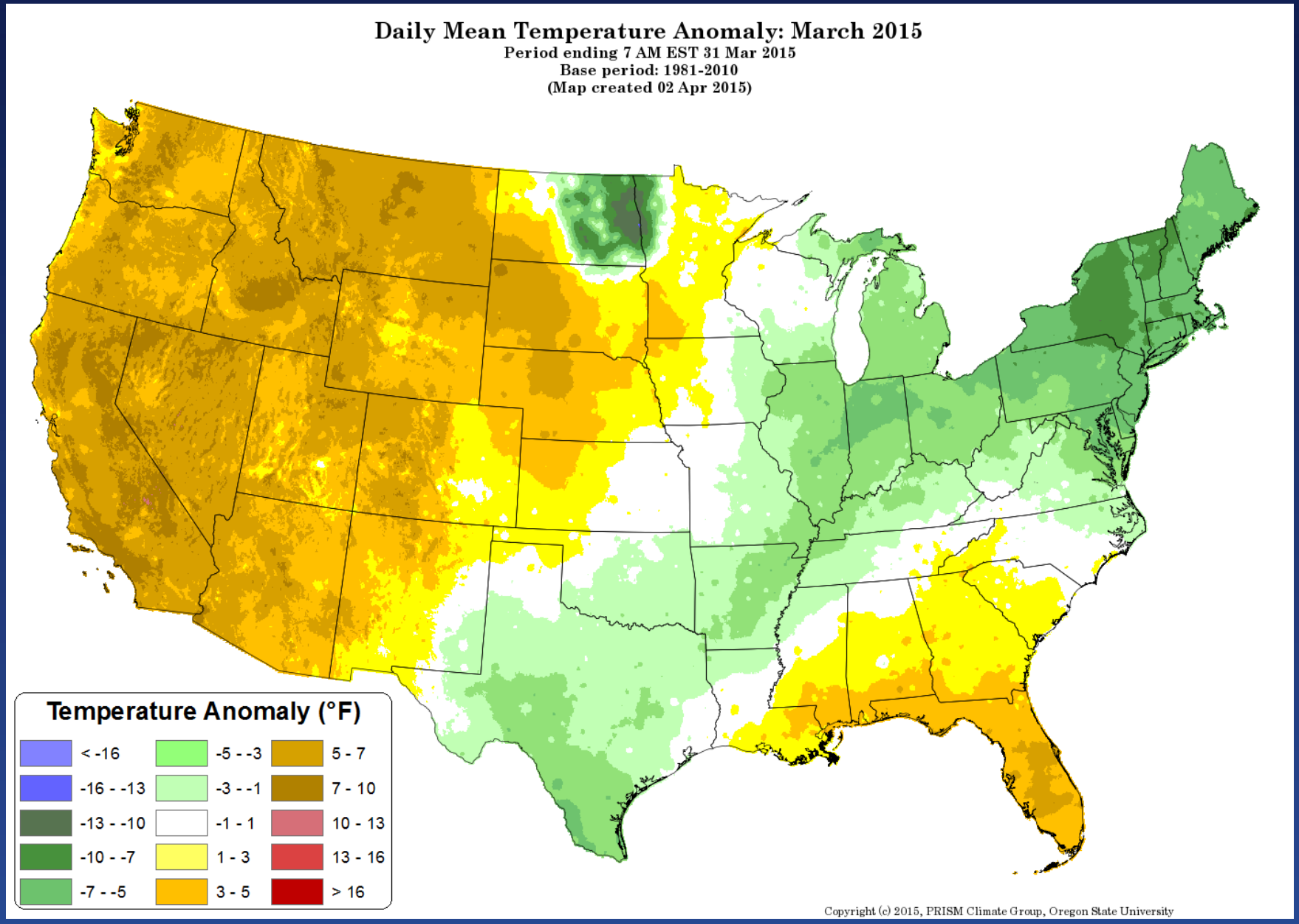
Montana Snow Survey



Montana Snow Survey



Montana Snow Survey

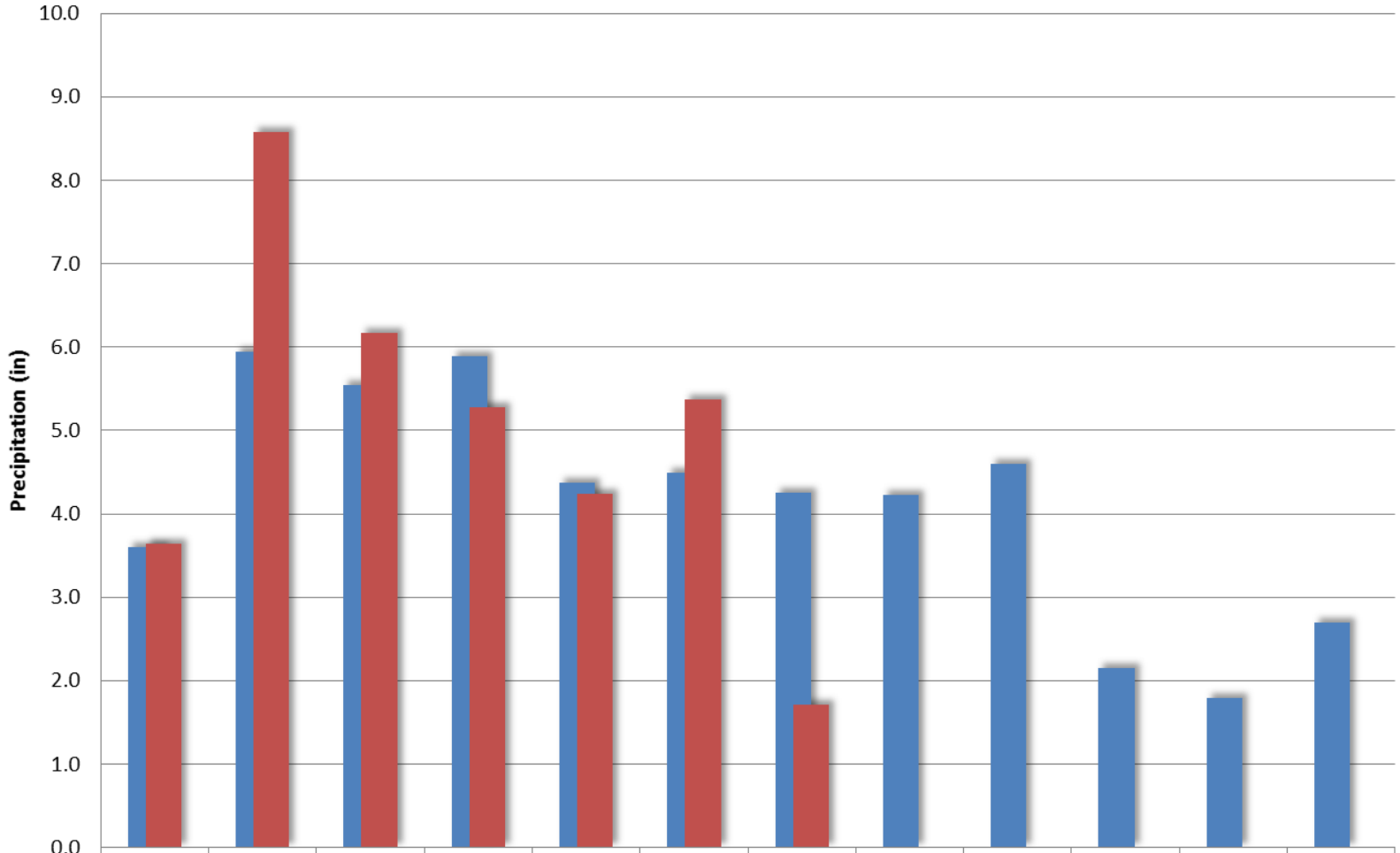


Precipitation

Montana Snow Survey

Flathead in Montana

SNOTEL Monthly Precipitation
4/21/2015

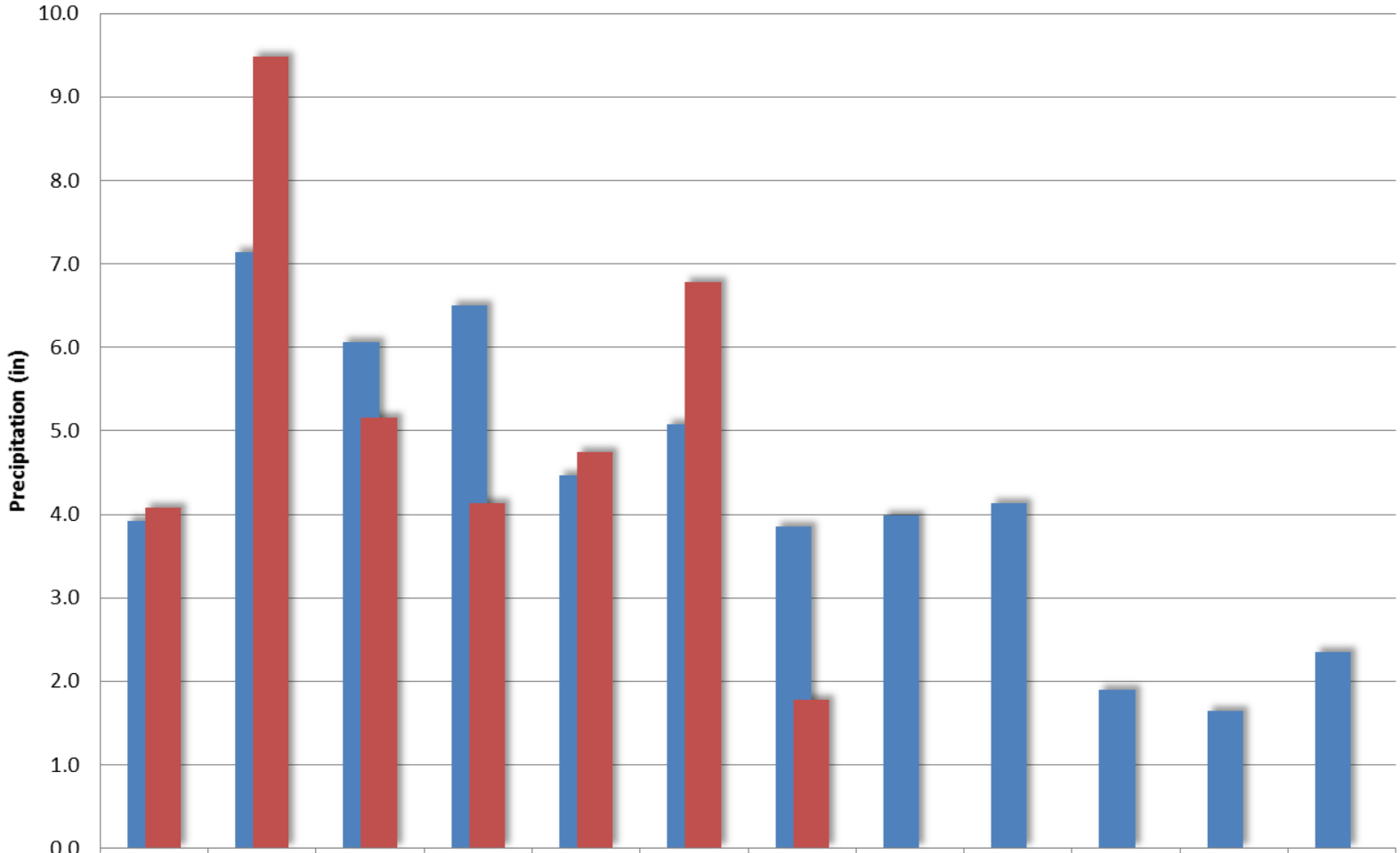


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	3.6	6.0	5.5	5.9	4.4	4.5	4.3	4.2	4.6	2.1	1.8	2.7
Monthly PCP (in)	3.6	8.6	6.2	5.3	4.2	5.4	1.7	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Kootenai in Montana

SNOTEL Monthly Precipitation
4/21/2015

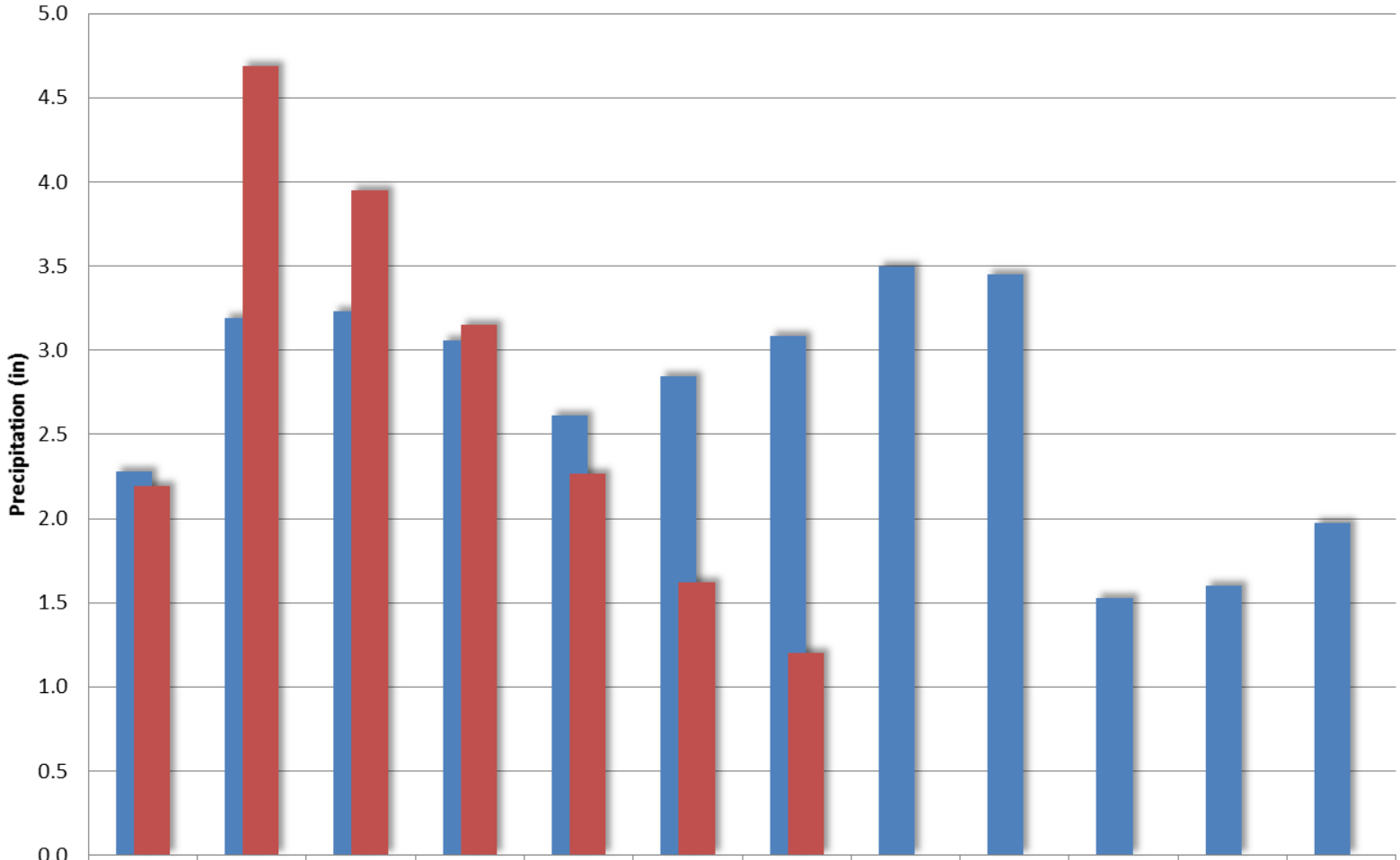


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	3.9	7.1	6.1	6.5	4.5	5.1	3.9	4.0	4.1	1.9	1.7	2.3
Monthly PCP (in)	4.1	9.5	5.2	4.1	4.8	6.8	1.8	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Upper Clark Fork Basin

SNOTEL Monthly Precipitation
4/21/2015

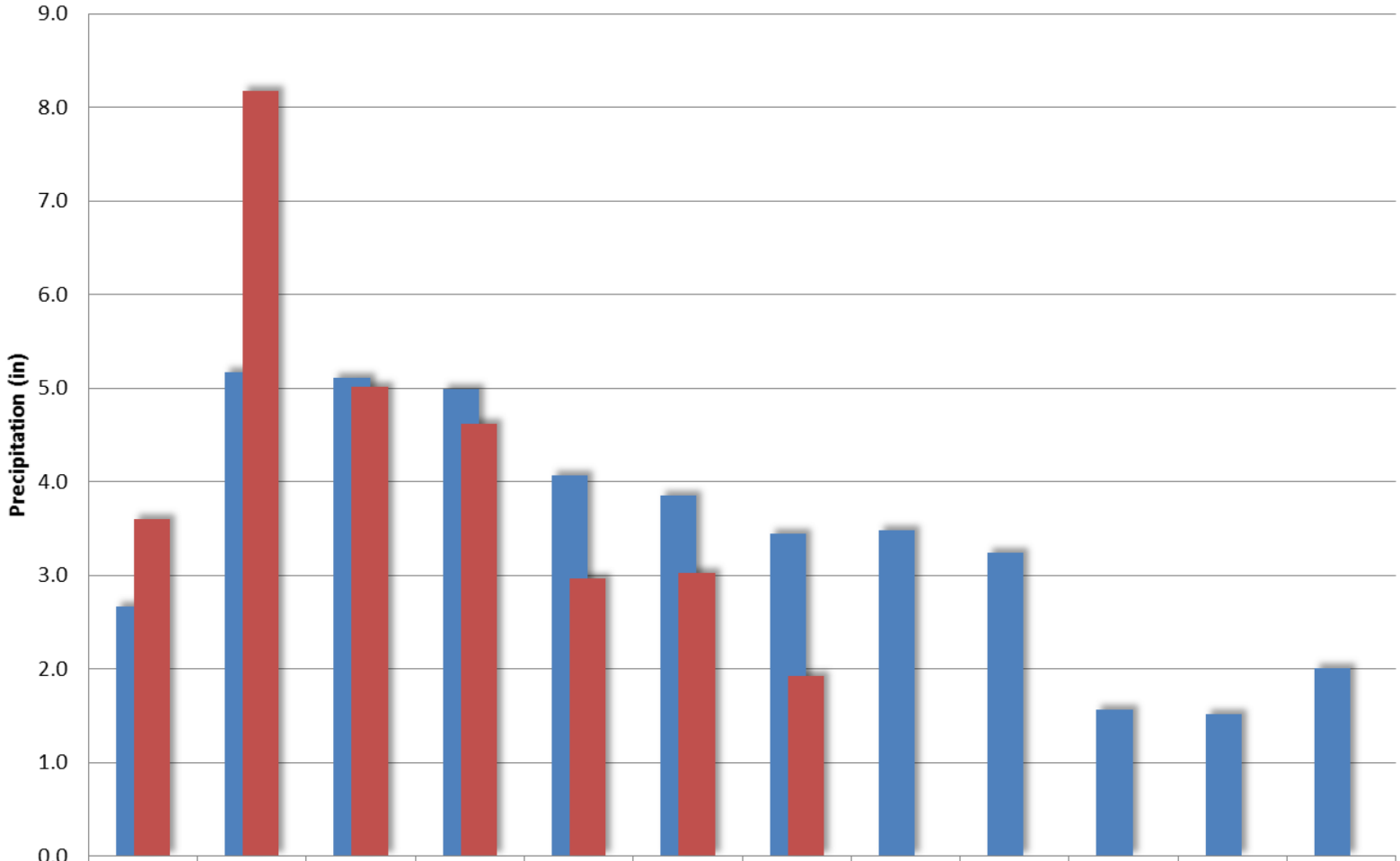


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	2.3	3.2	3.2	3.1	2.6	2.8	3.1	3.5	3.4	1.5	1.6	2.0
Monthly PCP (in)	2.2	4.7	4.0	3.2	2.3	1.6	1.2	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Bitterroot River Basin

SNOTEL Monthly Precipitation
4/21/2015

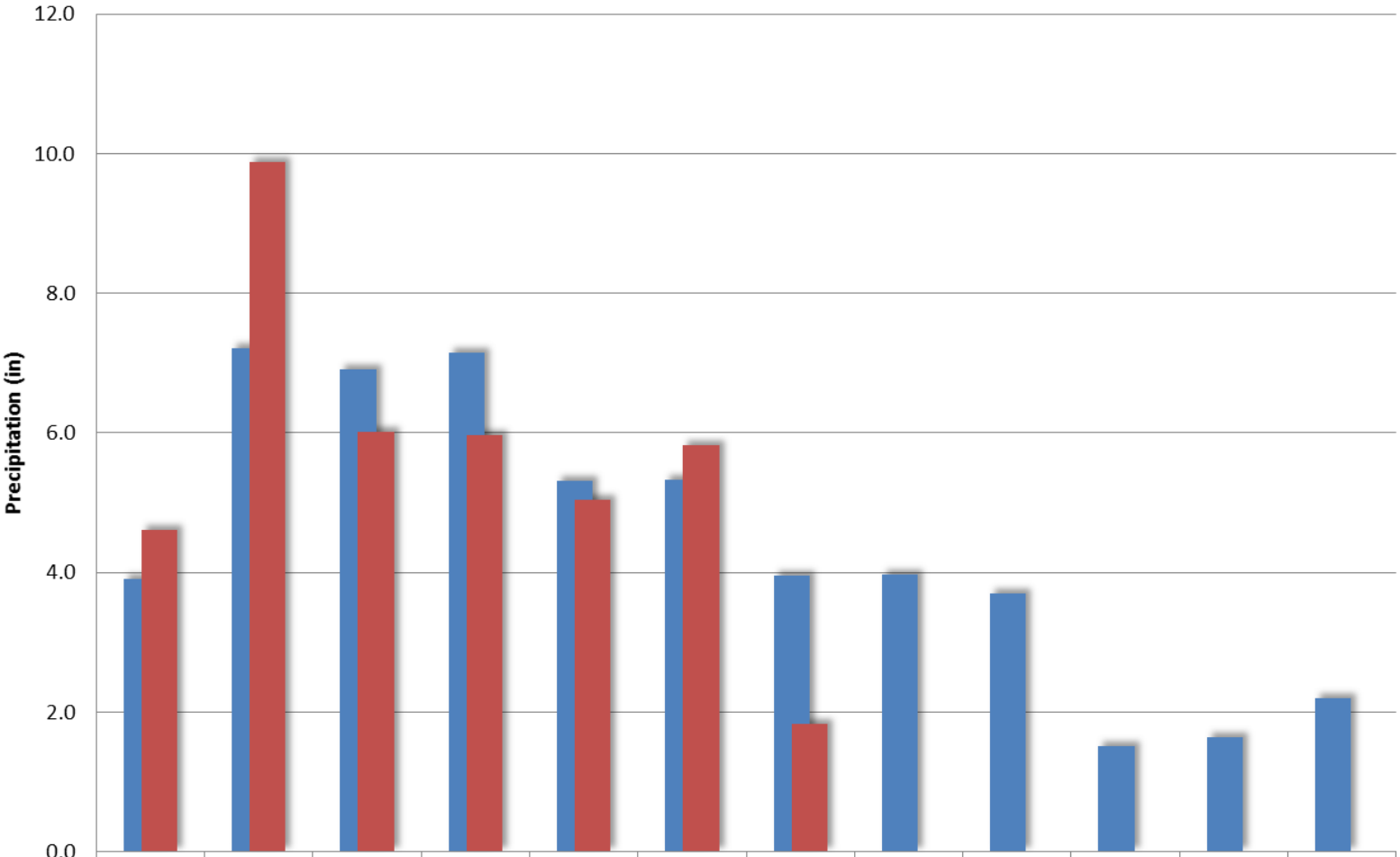


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	2.7	5.2	5.1	5.0	4.1	3.8	3.4	3.5	3.2	1.6	1.5	2.0
Monthly PCP (in)	3.6	8.2	5.0	4.6	3.0	3.0	1.9	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Lower Clark Fork Basin

SNOTEL Monthly Precipitation
4/21/2015

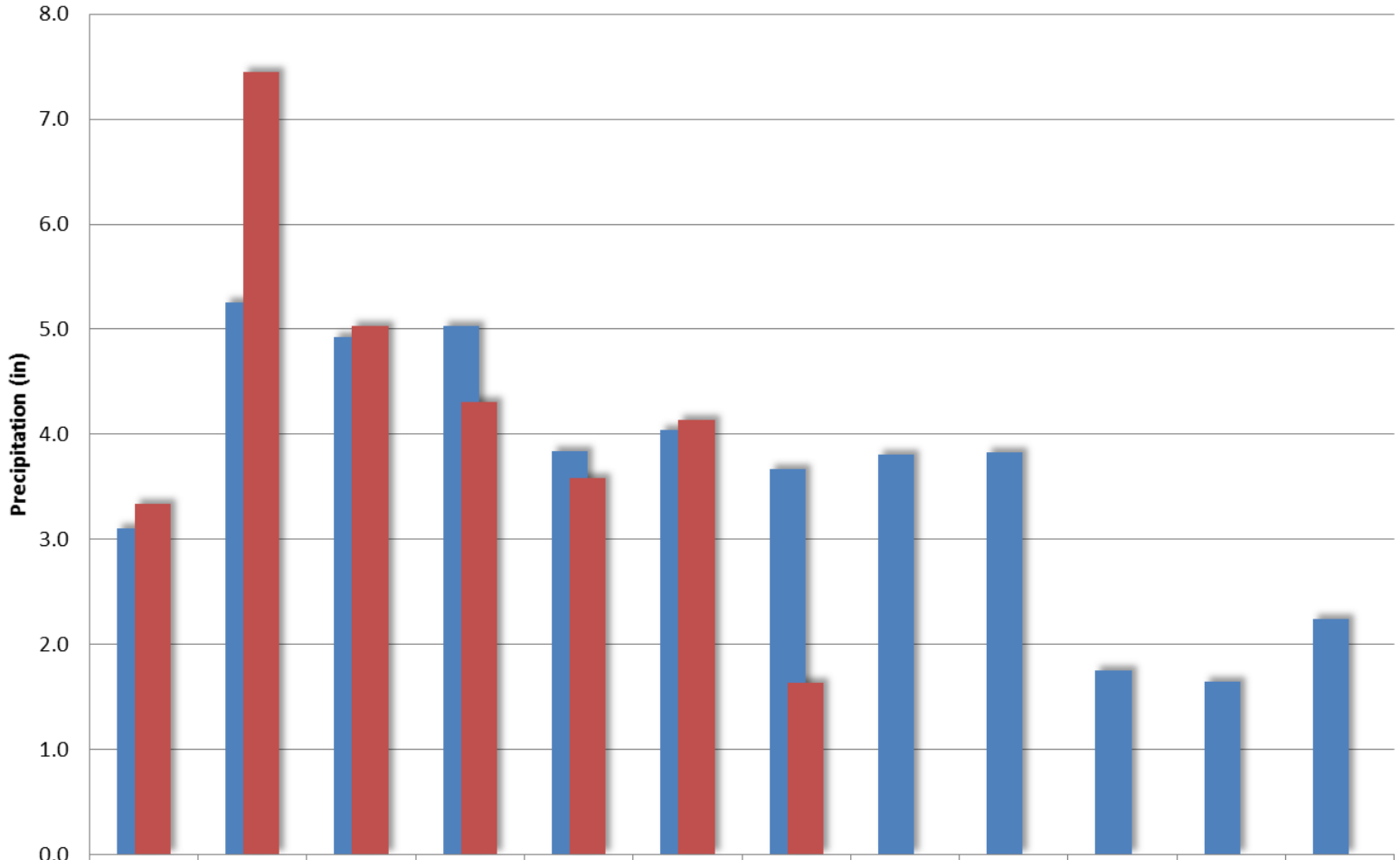


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	3.9	7.2	6.9	7.2	5.3	5.3	4.0	4.0	3.7	1.5	1.6	2.2
Monthly PCP (in)	4.6	9.9	6.0	6.0	5.0	5.8	1.8	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Columbia In Montana

SNOTEL Monthly Precipitation
4/21/2015

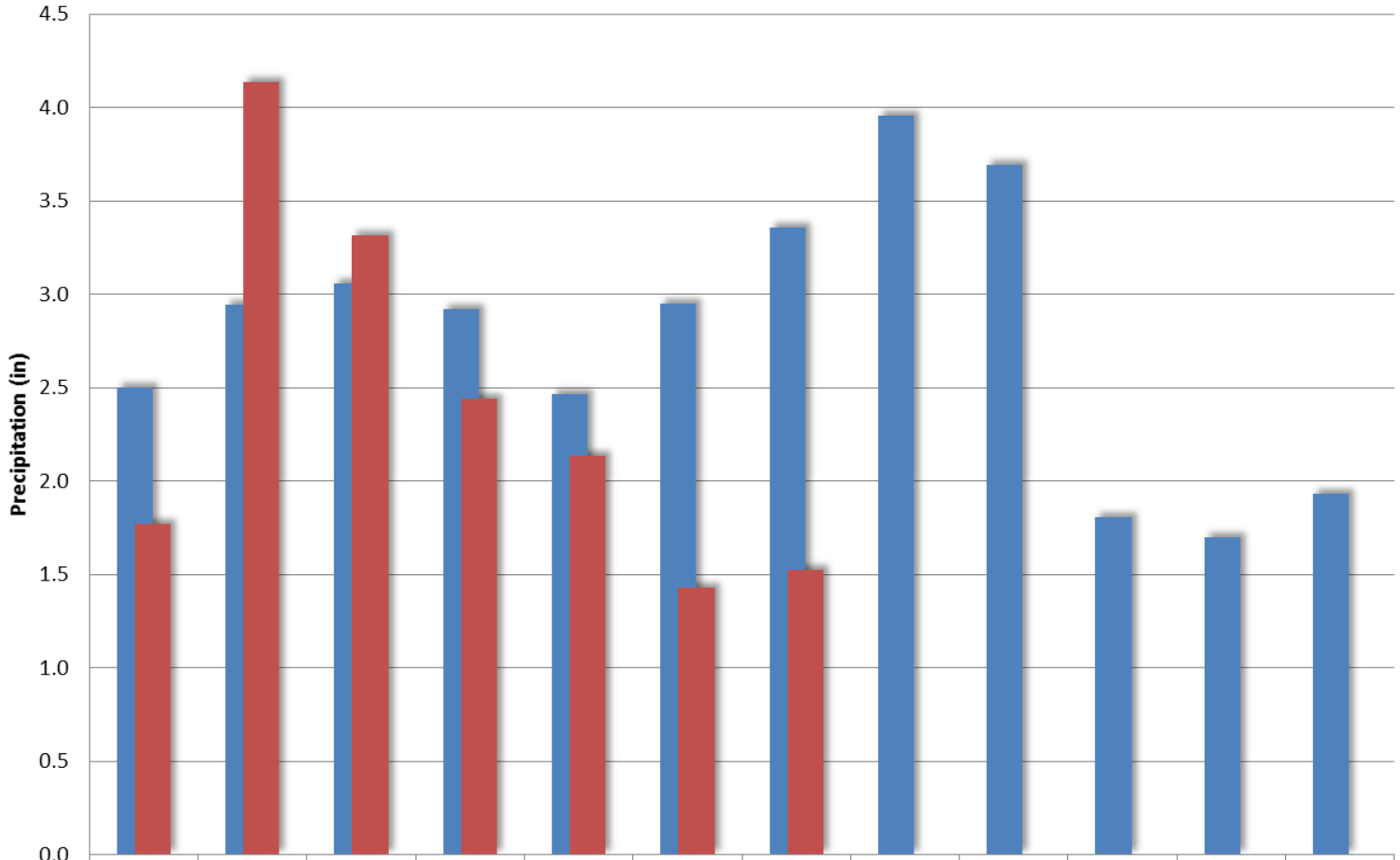


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	3.1	5.3	4.9	5.0	3.8	4.0	3.7	3.8	3.8	1.8	1.6	2.2
Monthly PCP (in)	3.3	7.5	5.0	4.3	3.6	4.1	1.6	0.0	0.0	0.0	0.0	0.0

Montana Snow Survey

Missouri River Basin

SNOTEL Monthly Precipitation
4/21/2015



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	2.5	2.9	3.1	2.9	2.5	3.0	3.4	4.0	3.7	1.8	1.7	1.9
Monthly PCP (in)	1.8	4.1	3.3	2.4	2.1	1.4	1.5	0.0	0.0	0.0	0.0	0.0

Snowpack

April 1, 2015 Snowpack Summary

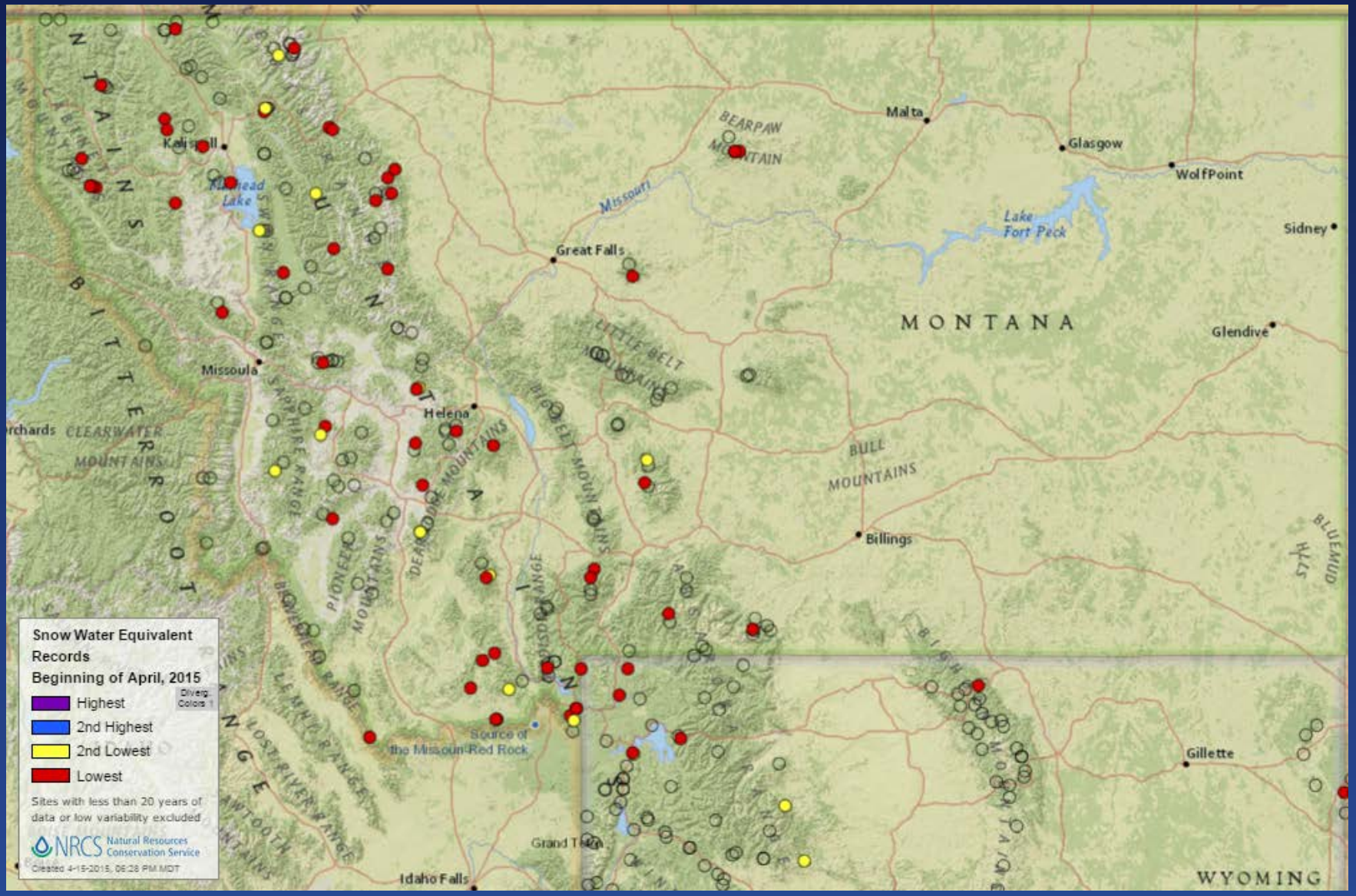
Using both SNOTEL and Snow Course observations

April 1st, 2015 Snow Water Equivalent		
River Basin	**April 1 % of Median**	**Monthly Change**
Columbia	**67**	**-19%**
Kootenai	49	-11%
Flathead	72	-16%
Upper Clark Fork	77	-29%
Bitterroot	78	-20%
Lower Clark Fork	49	-16%
Missouri	**67**	**-27%**
Missouri Headwaters	70	-25%
Jefferson	74	-26%
Madison	62	-18%
Gallatin	77	-20%
Missouri Mainstem	67	-32%
Headwaters Mainstem	77	-35%
Smith-Judith Musselshell	81	-28%
Sun-Teton-Marias	53	-34%
Milk	0	-48%
St. Mary	53	-24%
St. Mary & Milk	45	-20%
Yellowstone	**81**	**-26%**
Upper Yellowstone	81	-25%
Lower Yellowstone	80	-27%

East of Divide	72	-26%
West of Divide	67	-19%
Statewide	**68**	**--23%**

Montana Snow Survey

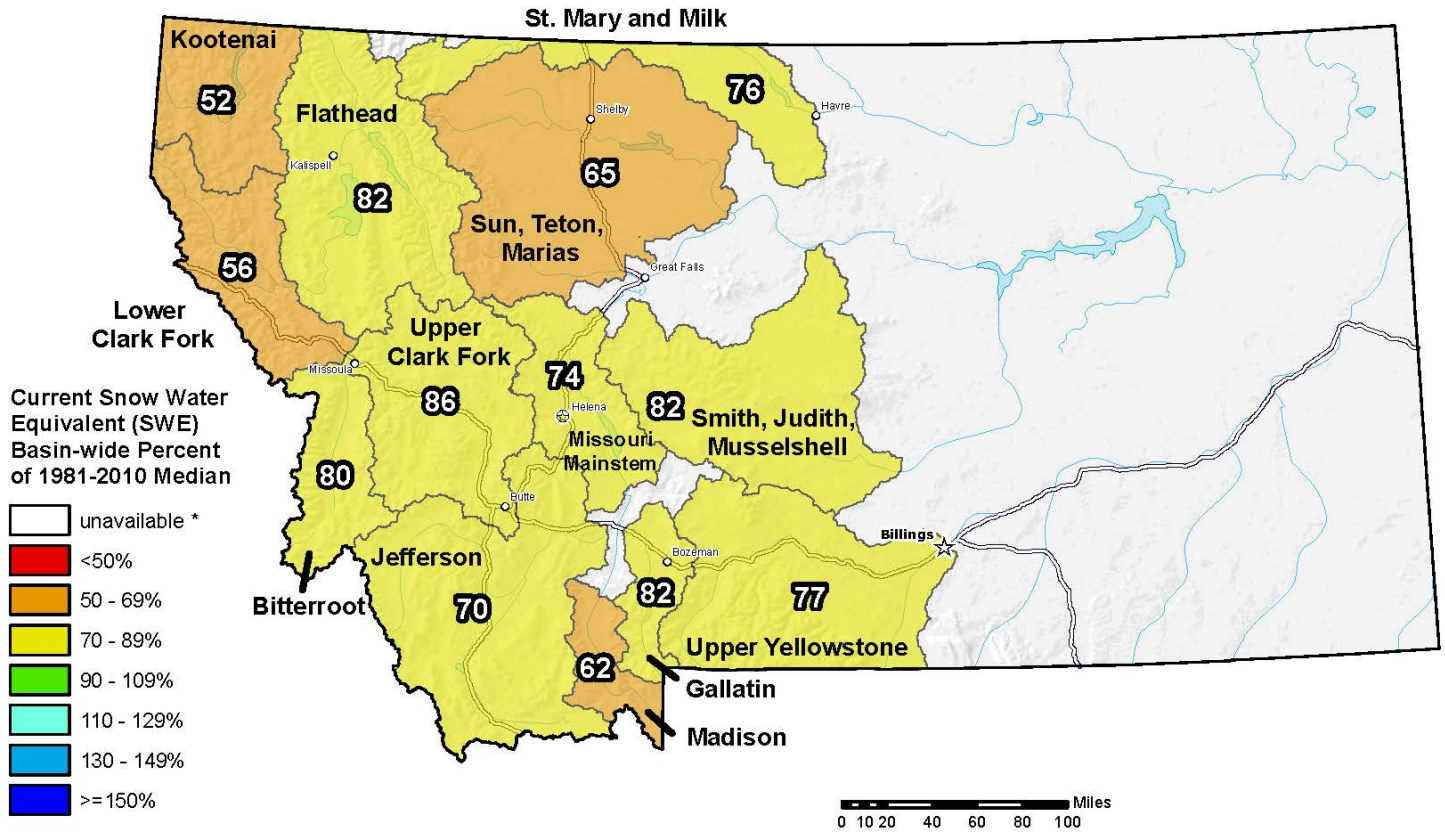
April 1st, 2015 Record Low SWE



Montana Snow Survey

Montana SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Apr 21, 2015



Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median

- unavailable *
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 149%
- >=150%

* *Data unavailable at time of posting or measurement is not representative at this time of year*

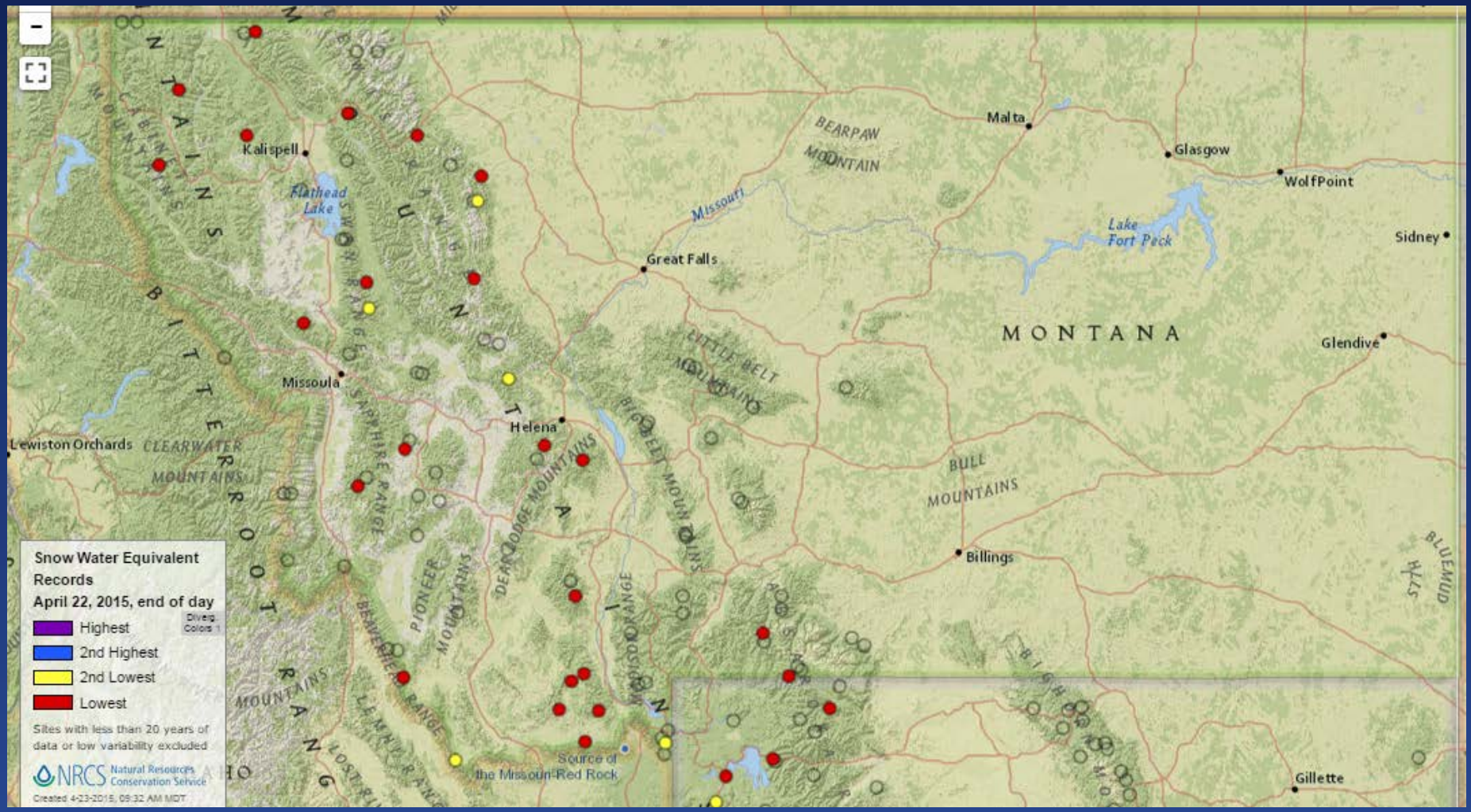
Provisional Data Subject to Revision

The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

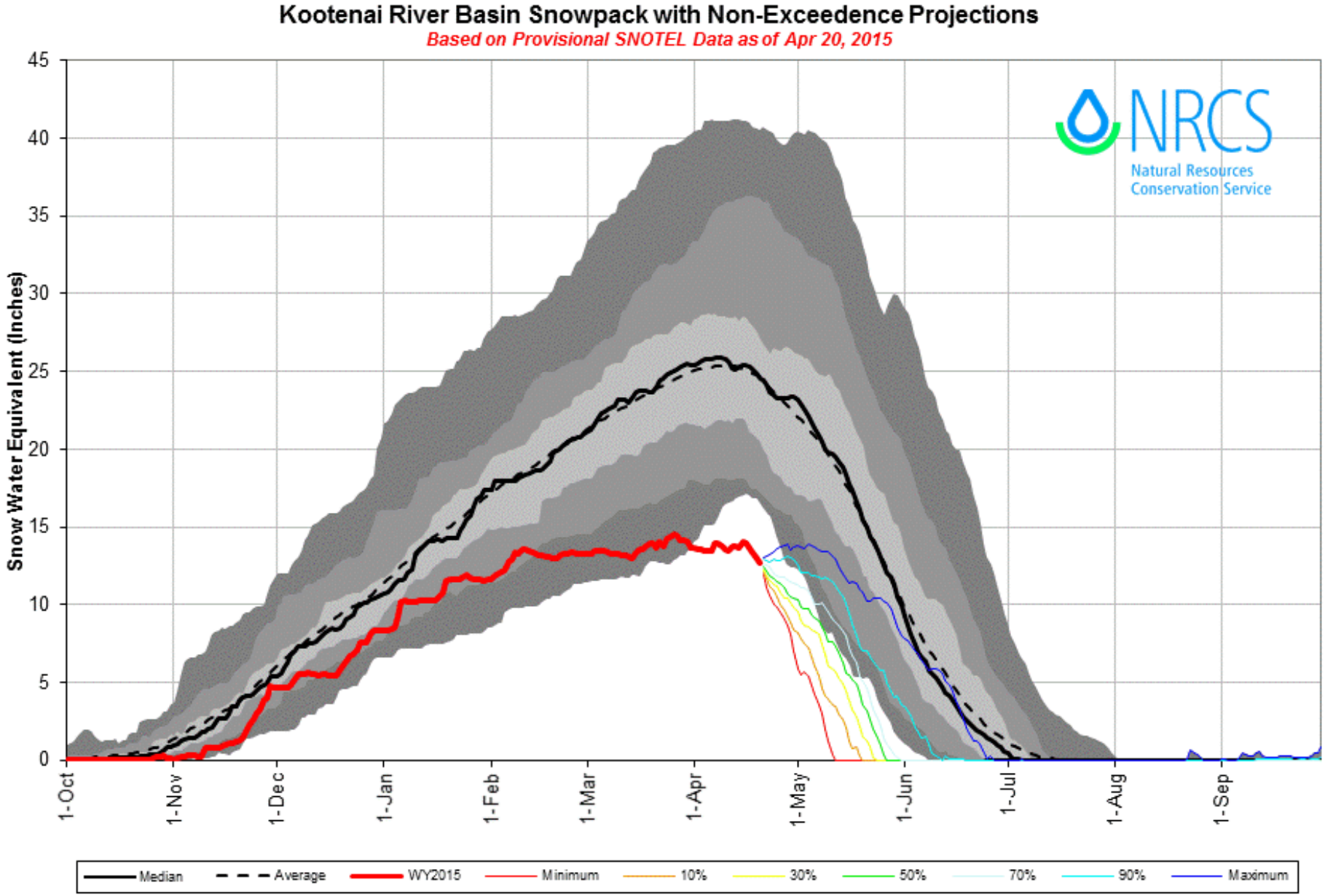
Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

Montana Snow Survey

April 22nd, 2015 Record Low SWE



Montana Snow Survey



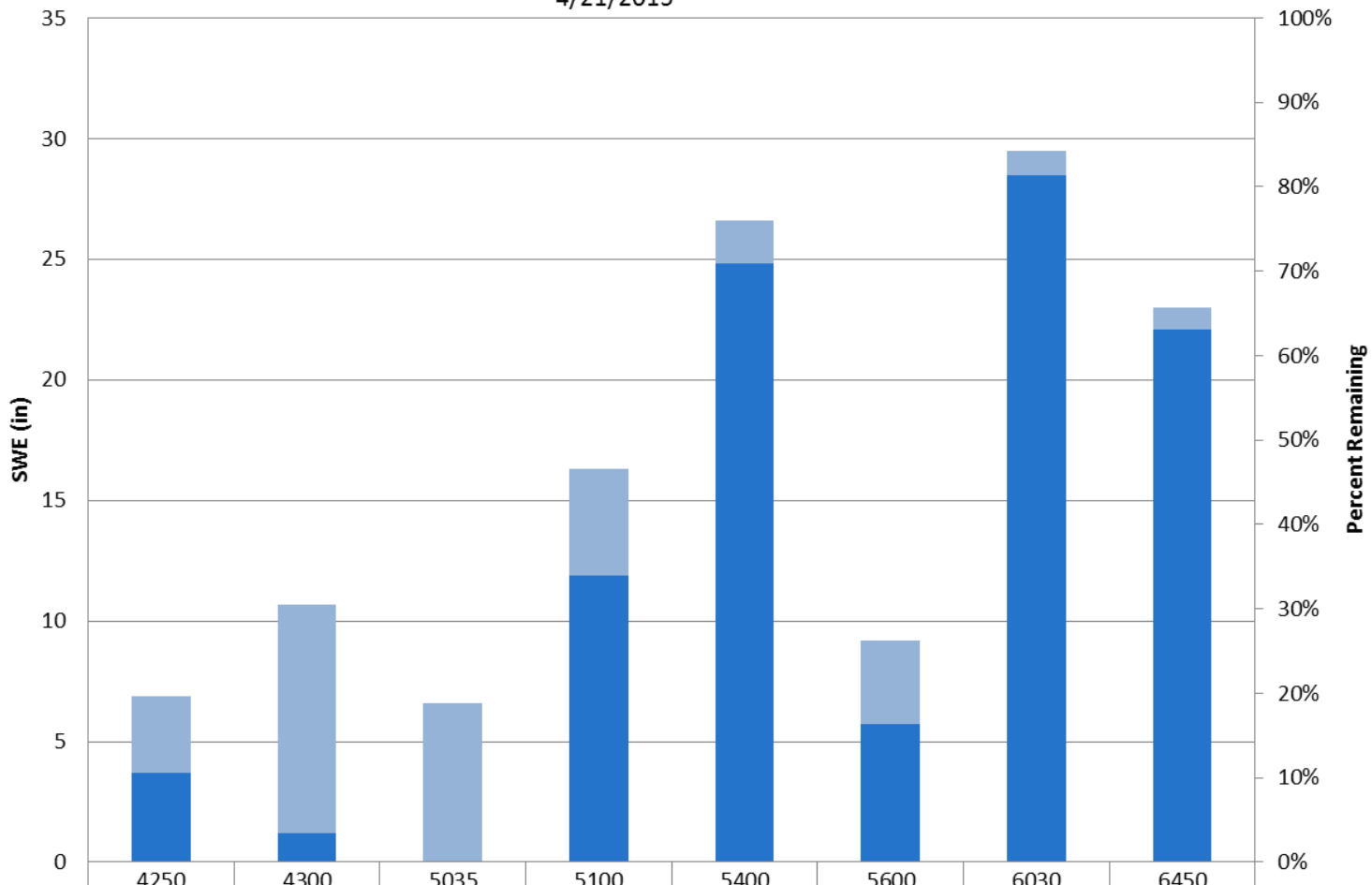
Montana Snow Survey

United States Department of Agriculture NRCS Natural Resources Conservation Service

Kootenai in Montana

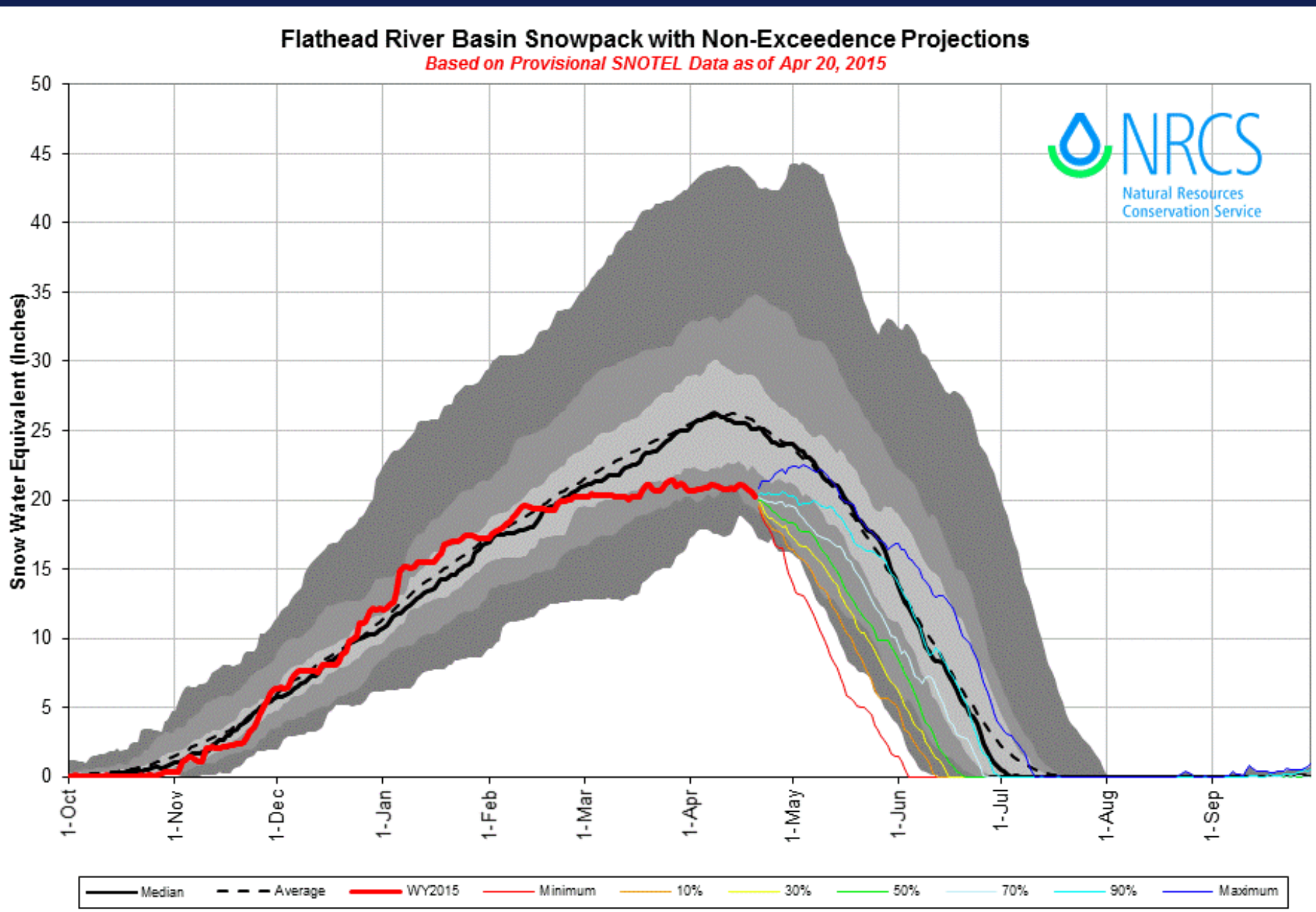
Percent Remaining Snowpack

4/21/2015



	4250	4300	5035	5100	5400	5600	6030	6450
Peak SWE	6.9	10.7	6.6	16.3	26.6	9.2	29.5	23
Current SWE	3.7	1.2	0	11.9	24.8	5.7	28.5	22.1
Percent Remaining	54%	11%	0%	73%	93%	62%	97%	96%
Percent of Normal	63%	13%	0%	39%	45%	35%	79%	85%

Montana Snow Survey



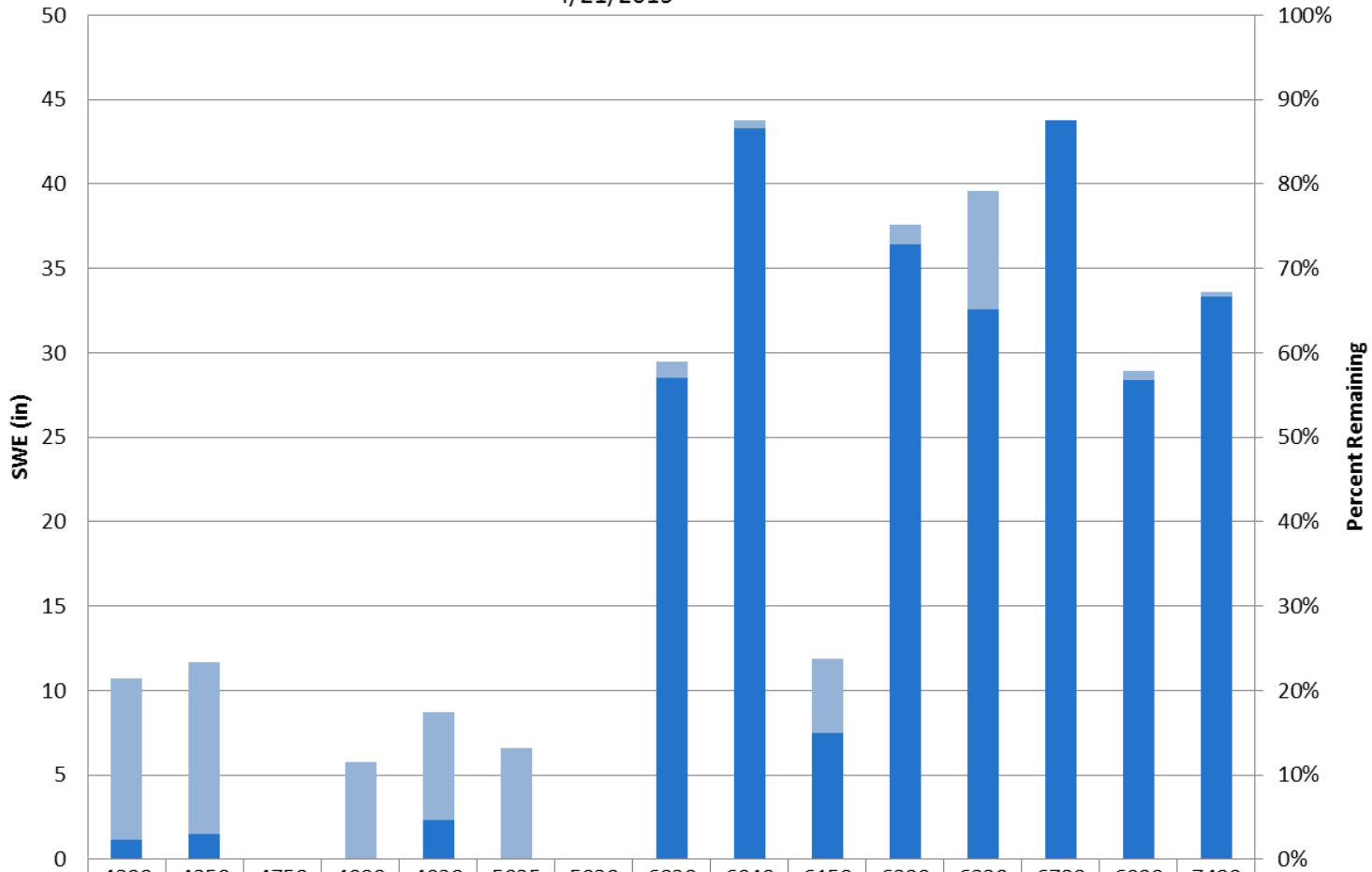
Montana Snow Survey

United States Department of Agriculture NRCS Natural Resources Conservation Service

Flathead in Montana

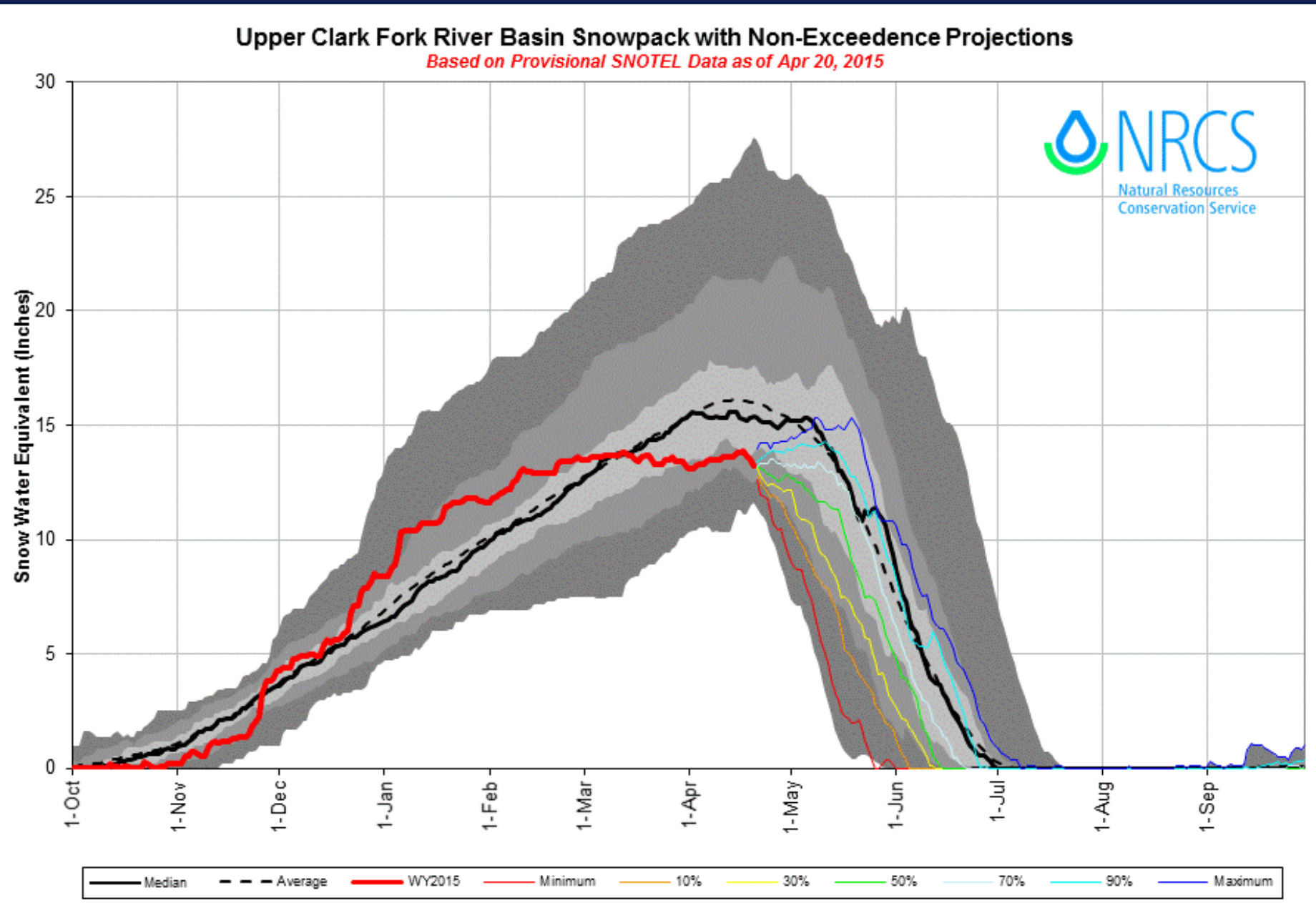
Percent Remaining Snowpack

4/21/2015



	4300	4350	4750	4900	4920	5035	5930	6030	6040	6150	6300	6330	6780	6900	7400
Peak SWE	10.7	11.7	0	5.8	8.7	6.6	0	29.5	43.8	11.9	37.6	39.6	43.8	28.9	33.6
Current SWE	1.2	1.5	0	0	2.3	0	0	28.5	43.3	7.5	36.4	32.6	43.8	28.4	33.3
Percent Remaining	11%	13%		0%	26%	0%		97%	99%	63%	97%	82%	100%	98%	99%
Percent of Normal	13%	16%		0%	28%	0%		79%	99%	57%	86%	80%	114%	94%	112%

Montana Snow Survey



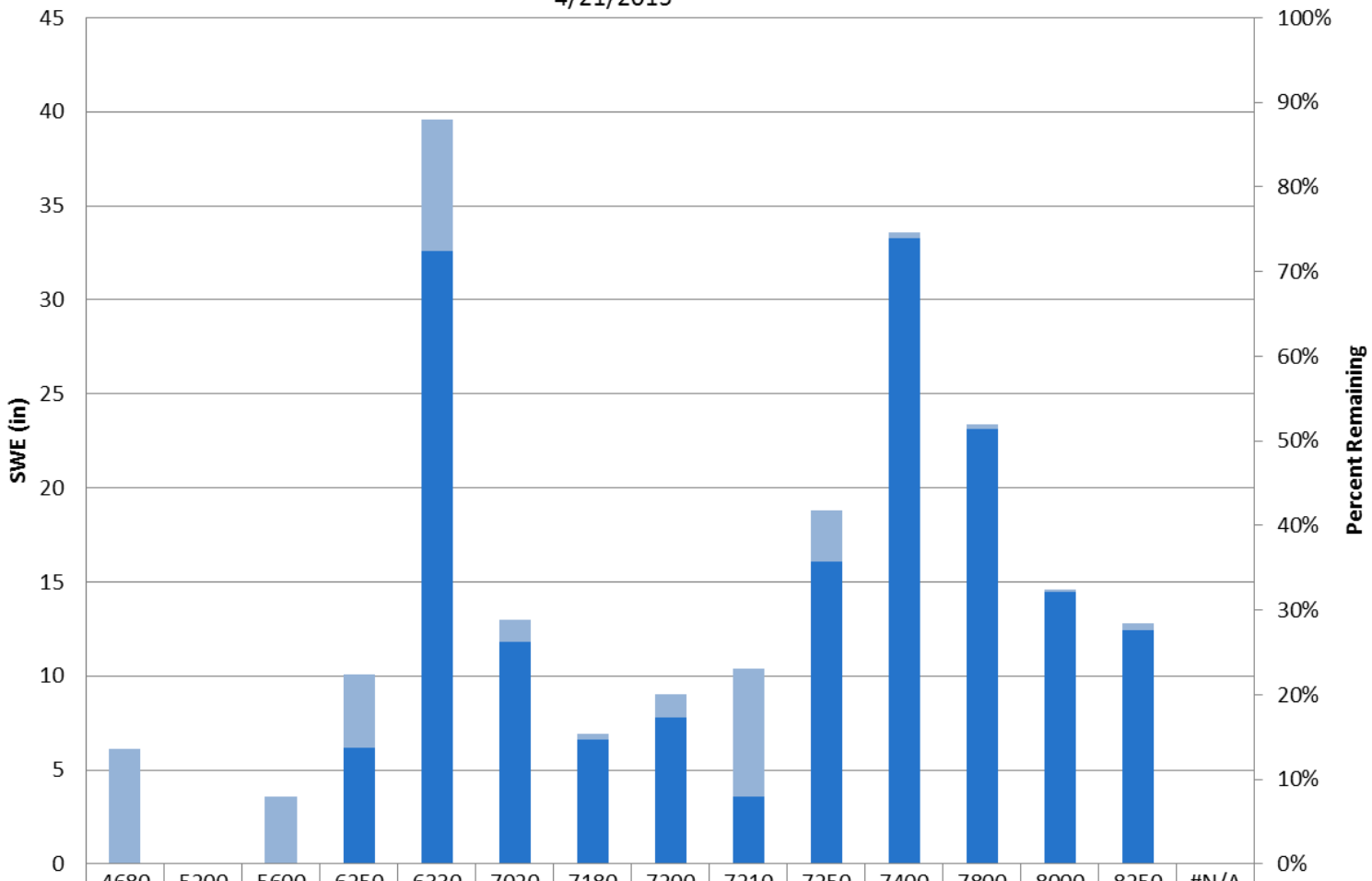
Montana Snow Survey

United States Department of Agriculture NRCS Natural Resources Conservation Service

Upper Clark Fork Basin

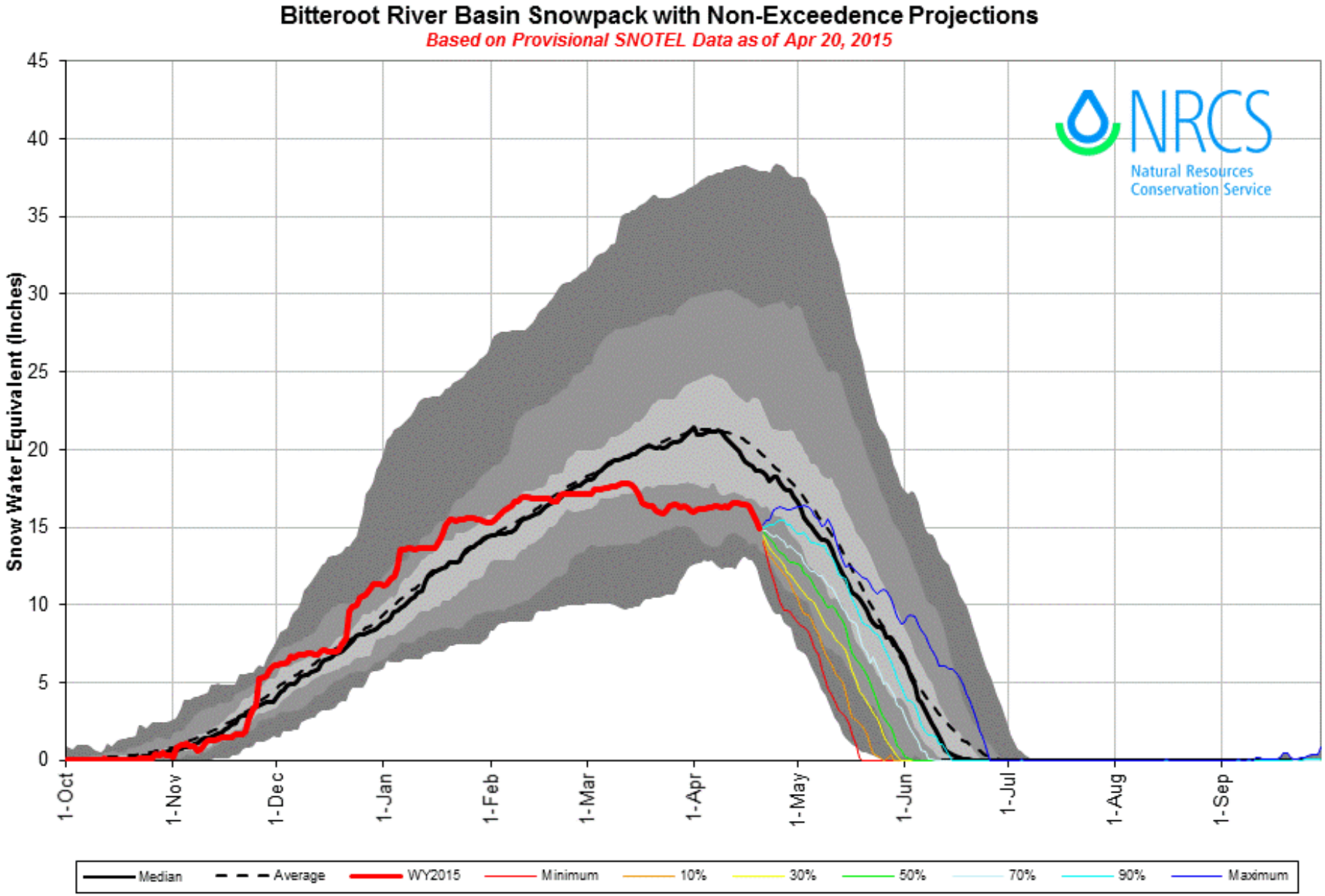
Percent Remaining Snowpack

4/21/2015



	4680	5200	5600	6250	6330	7020	7180	7200	7210	7250	7400	7800	8000	8250	#N/A
Peak SWE	6.1	0	3.6	10.1	39.6	13	6.9	9	10.4	18.8	33.6	23.4	14.6	12.8	0
Current SWE	0	0	0	6.2	32.6	11.8	6.6	7.8	3.6	16.1	33.3	23.1	14.5	12.4	0
Percent Remaining	0%		0%	61%	82%	91%	96%	87%	35%	86%	99%	99%	99%	97%	
Percent of Normal			0%	65%	80%	89%	74%	74%	37%	75%	112%	110%	101%	78%	

Montana Snow Survey



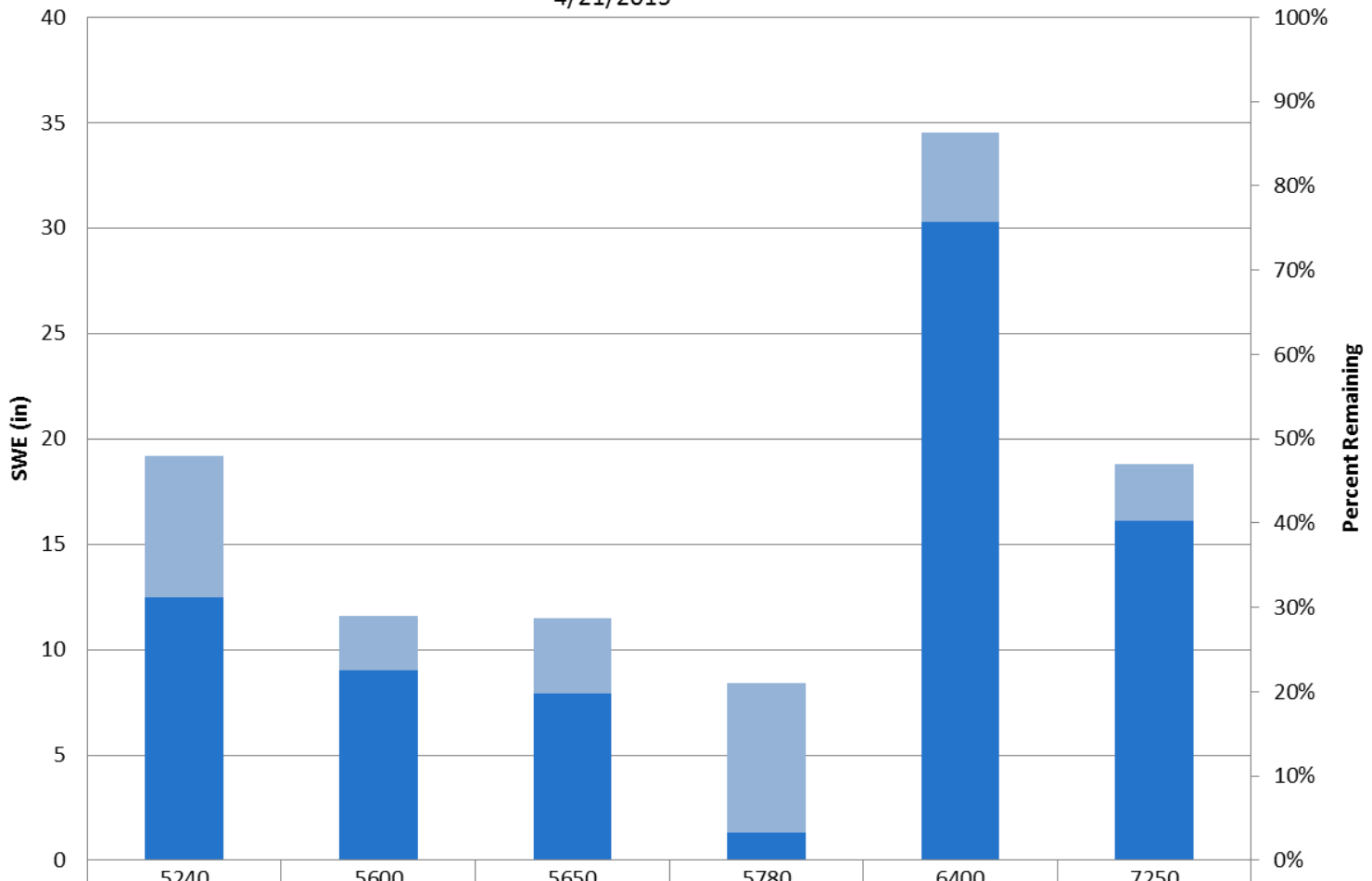
Montana Snow Survey

United States Department of Agriculture NRCS Natural Resources Conservation Service

Bitterroot River Basin

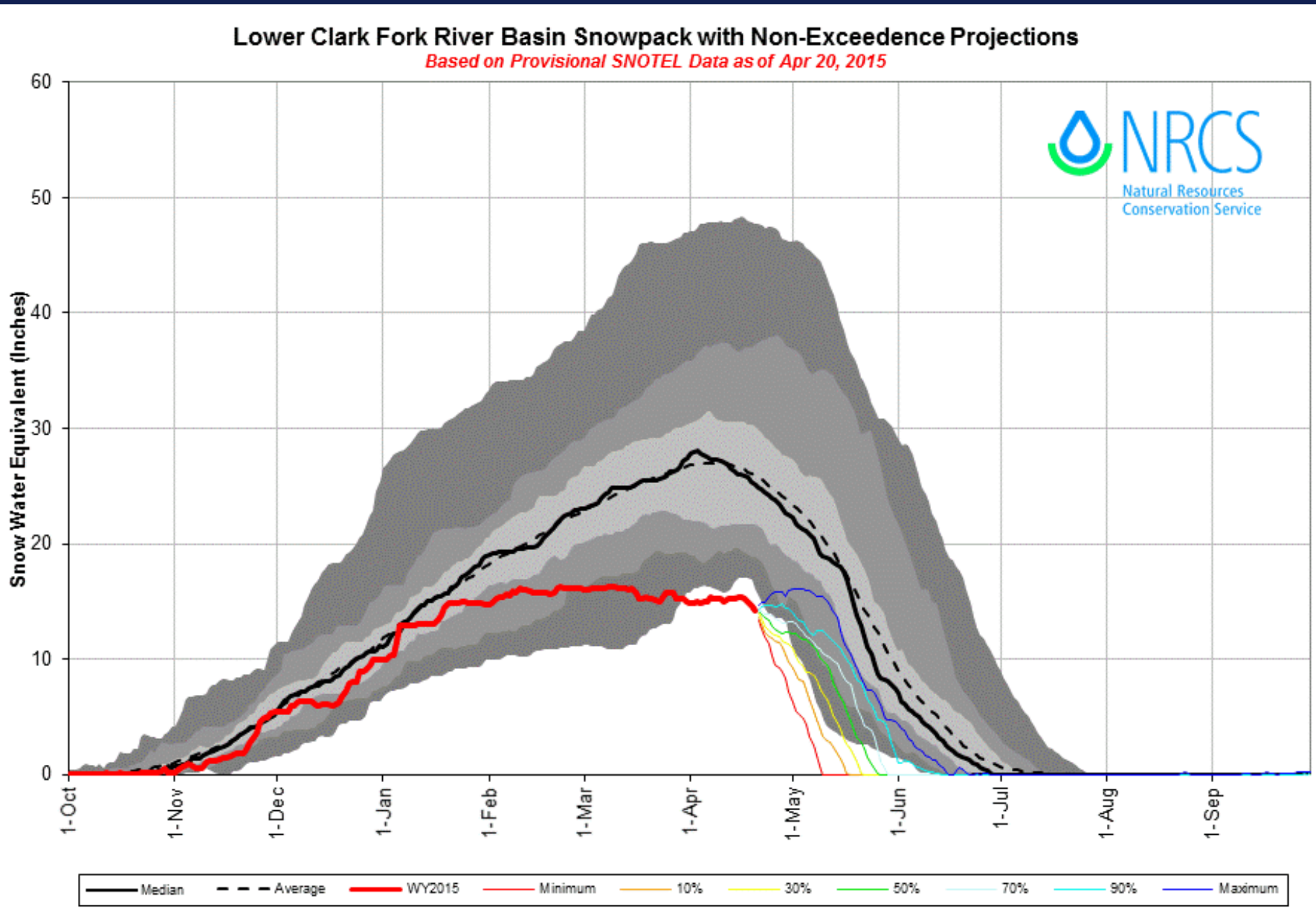
Percent Remaining Snowpack

4/21/2015



	5240	5600	5650	5780	6400	7250
Peak SWE	19.2	11.6	11.5	8.4	34.5	18.8
Current SWE	12.5	9	7.9	1.3	30.3	16.1
Percent Remaining	65%	78%	69%	15%	88%	86%
Percent of Normal	62%	108%	69%	20%	90%	75%

Montana Snow Survey



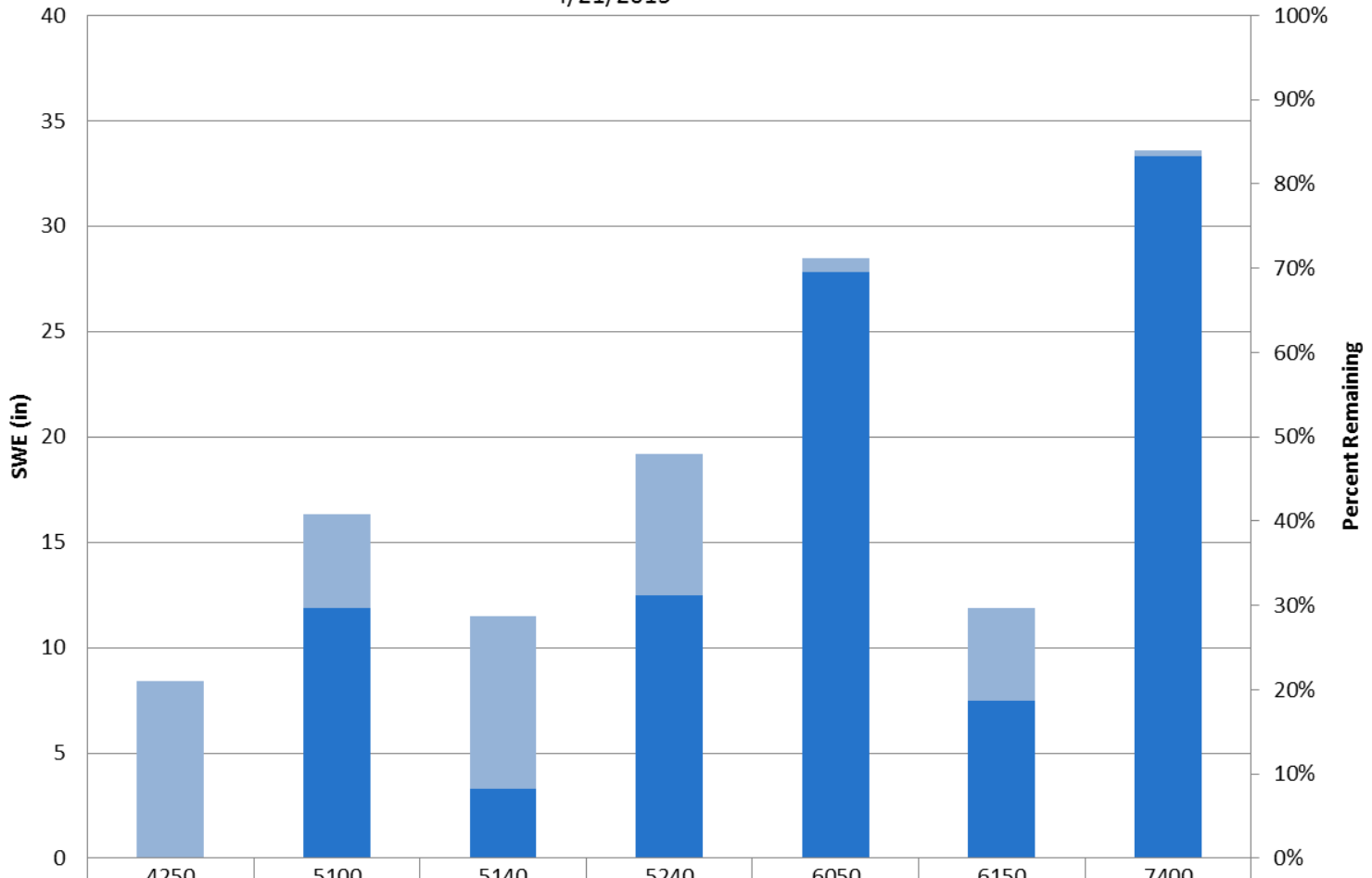
Montana Snow Survey

United States Department of Agriculture NRCS Natural Resources Conservation Service

Lower Clark Fork Basin

Percent Remaining Snowpack

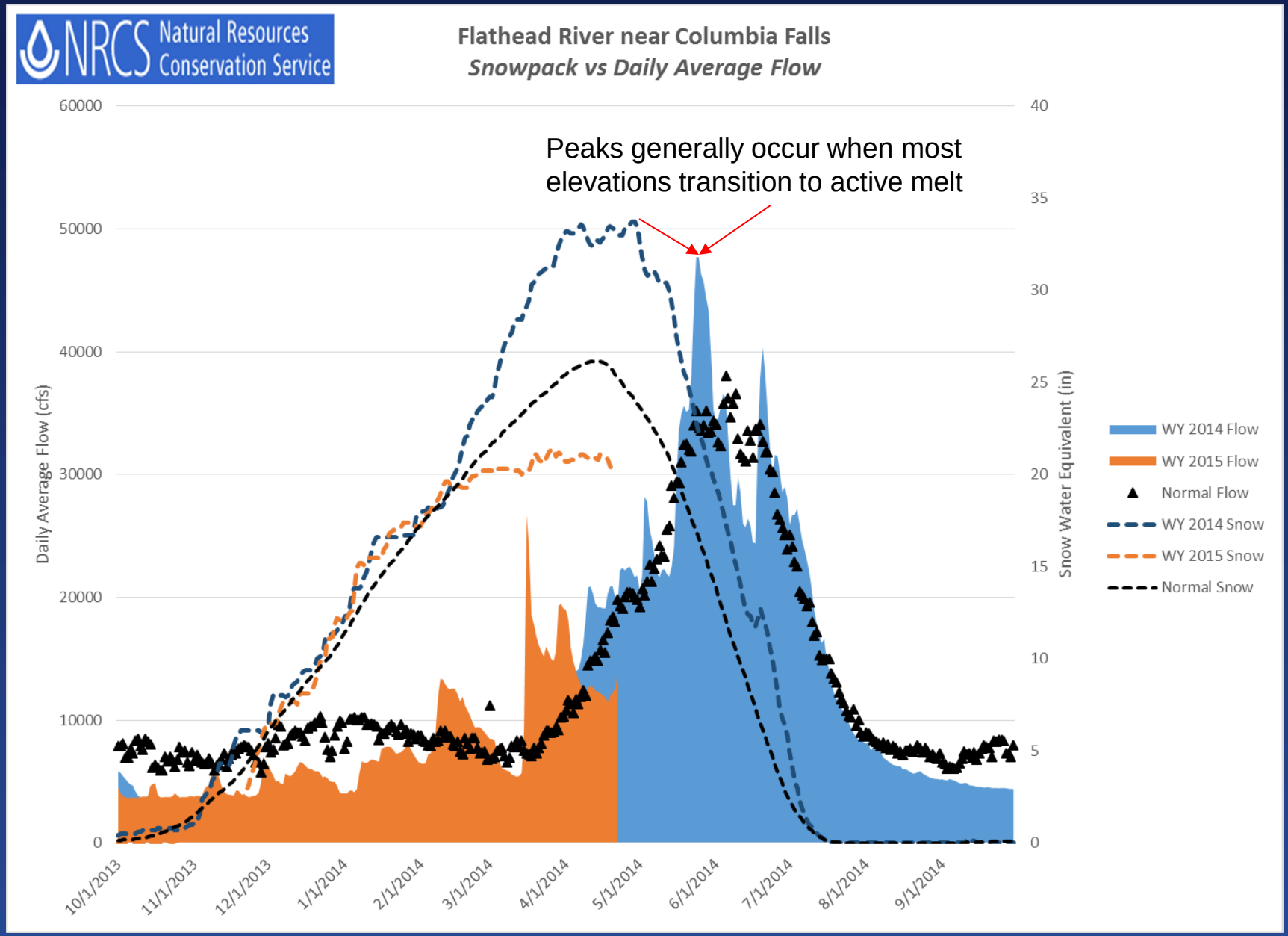
4/21/2015



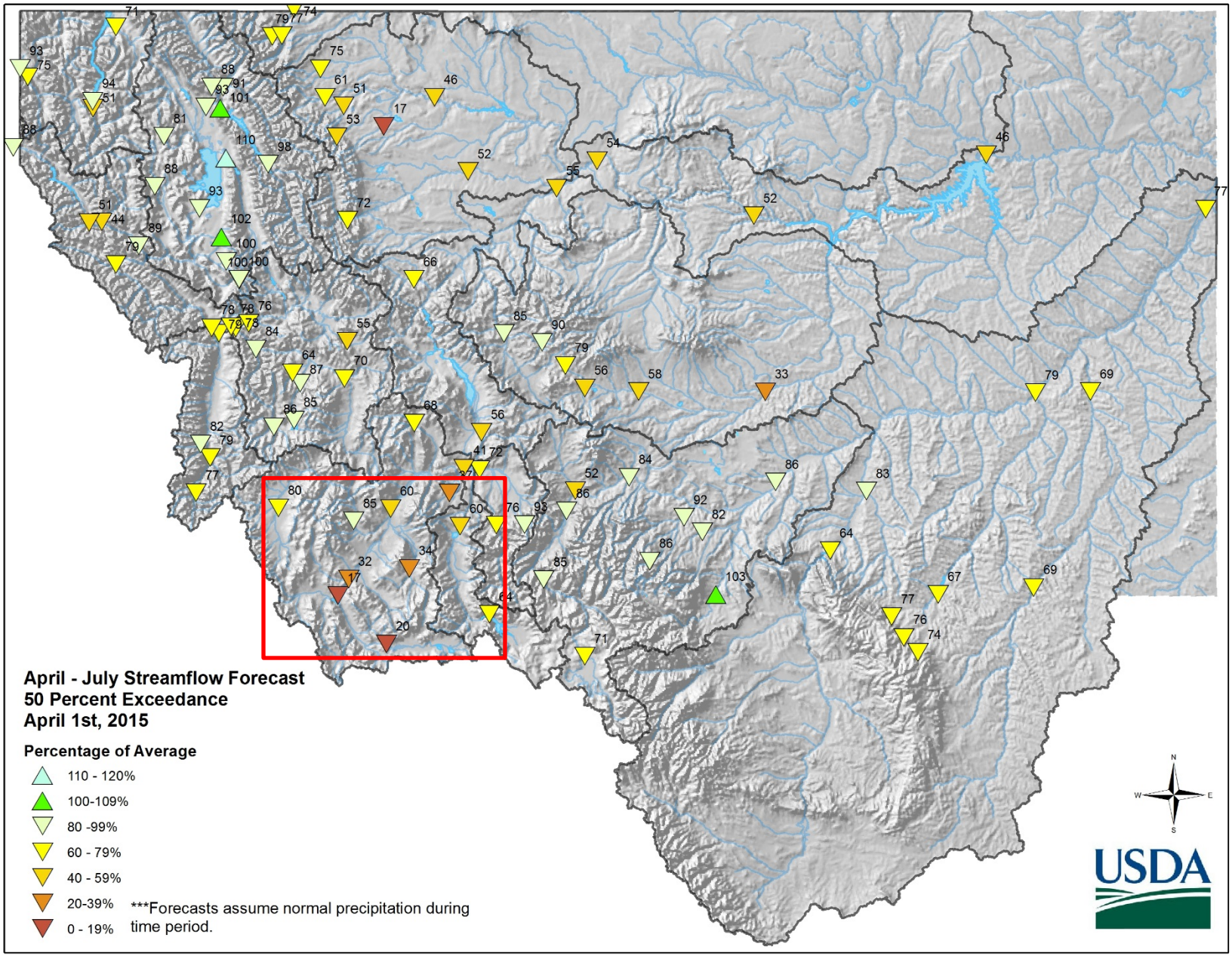
	4250	5100	5140	5240	6050	6150	7400
Peak SWE	8.4	16.3	11.5	19.2	28.5	11.9	33.6
Current SWE	0	11.9	3.3	12.5	27.8	7.5	33.3
Percent Remaining	0%	73%	29%	65%	98%	63%	99%
Percent of Normal	0%	39%	13%	62%	70%	57%	112%

Water Supply

Montana Snow Survey



Montana Snow Survey



Montana Snow Survey

April-July Streamflow Forecast Period		
River Basin	**Forecast as % of Average**	**Forecast as % Last Year's Flows**
Columbia	**89**	**67**
Kootenai	92	79
Flathead	94	68
Upper Clark Fork	78	56
Bitterroot	79	47
Lower Clark Fork	86	55
Missouri	**57**	**47**
Missouri Headwaters	60	54
Jefferson	55	48
Madison	61	63
Gallatin	74	65
Missouri Mainstem	56	45
Headwaters Mainstem	56	46
Smith-Judith Musselshell	64	42
Sun-Teton-Marias	59	43
St. Mary	76	54
Yellowstone	**80**	**52**
Upper Yellowstone	86	59
Lower Yellowstone	76	48
Statewide	**79**	**58**

Summary

- For the third straight month we have seen declines in snowpack percentage of normal, due to:
  - Low to Mid elevation melt from well above average temperatures
  - Lack of significant snowfall and well below average March

- Streamflow prospects have dropped due to the drops in snowpack percentages and below normal precipitation
  - Streamflow prospects are below average in most basins across the state
  - Some forecasts are near record lows for certain gauges in SW Montana, and some water users should be aware

Montana Snow Survey

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West Side Water and Climate Workshop
Snowpack and Streamflow Update
April 23rd, 2015

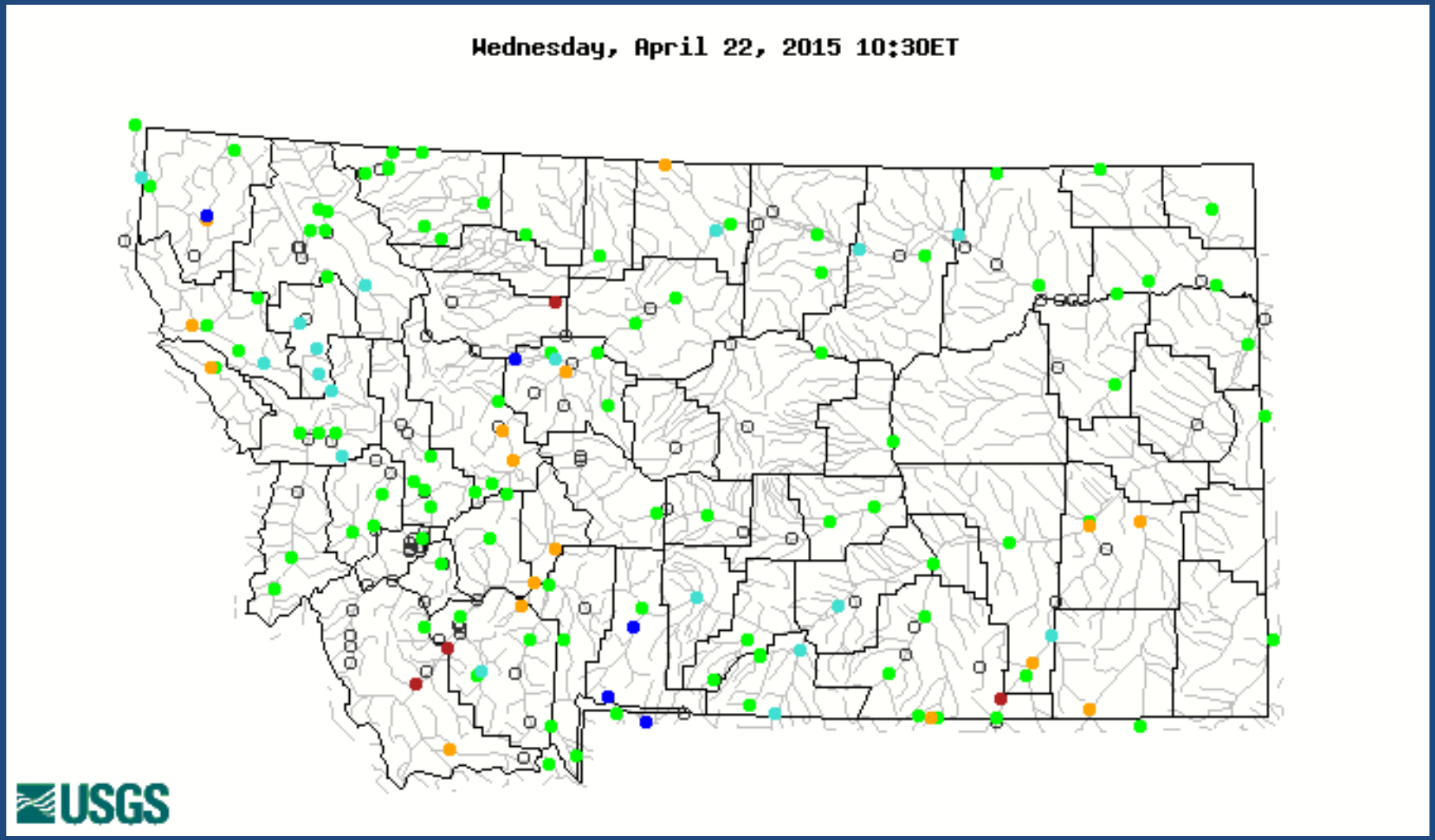
Combination and Black Pine SNOTEL sites. Low and Mid-elevation sites that have melted out as of April 22nd, 2015

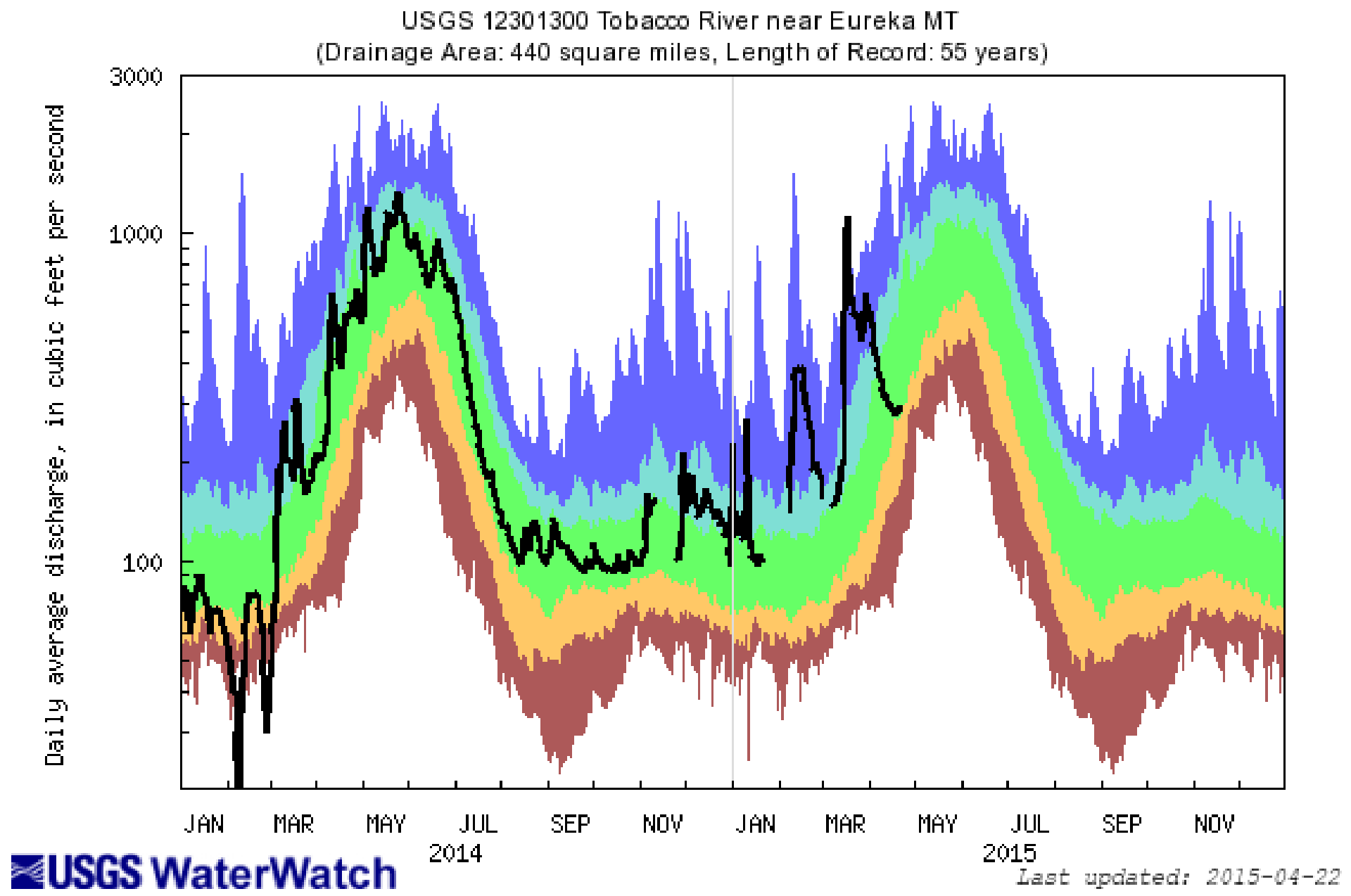
Lucas Zukiewicz
Water Supply Specialist (Snow Hydrologist)
USDA-NRCS
Montana Snow Surveys
Lucas.Zukiewicz@mt.usda.gov
406-587-6843

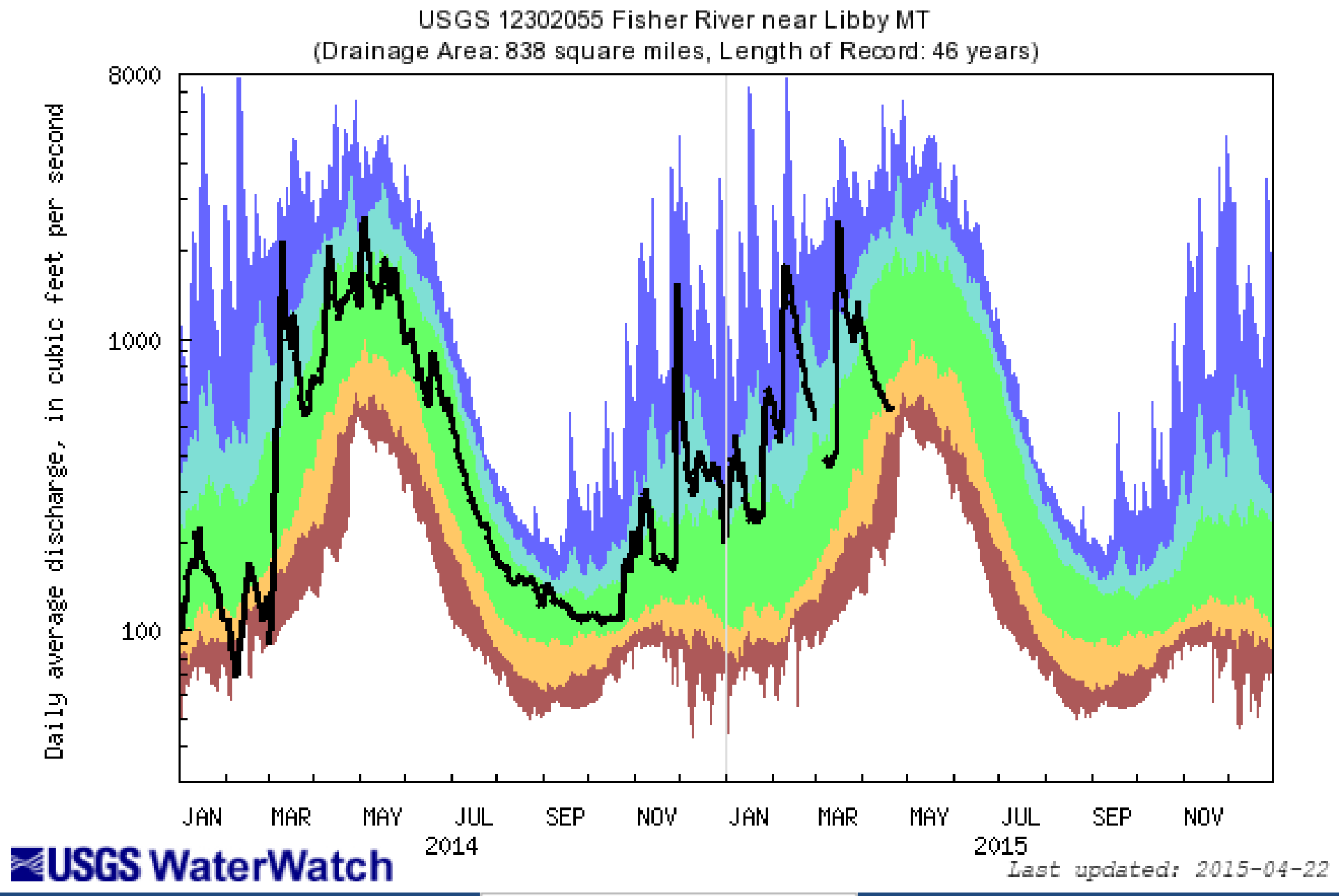
http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/

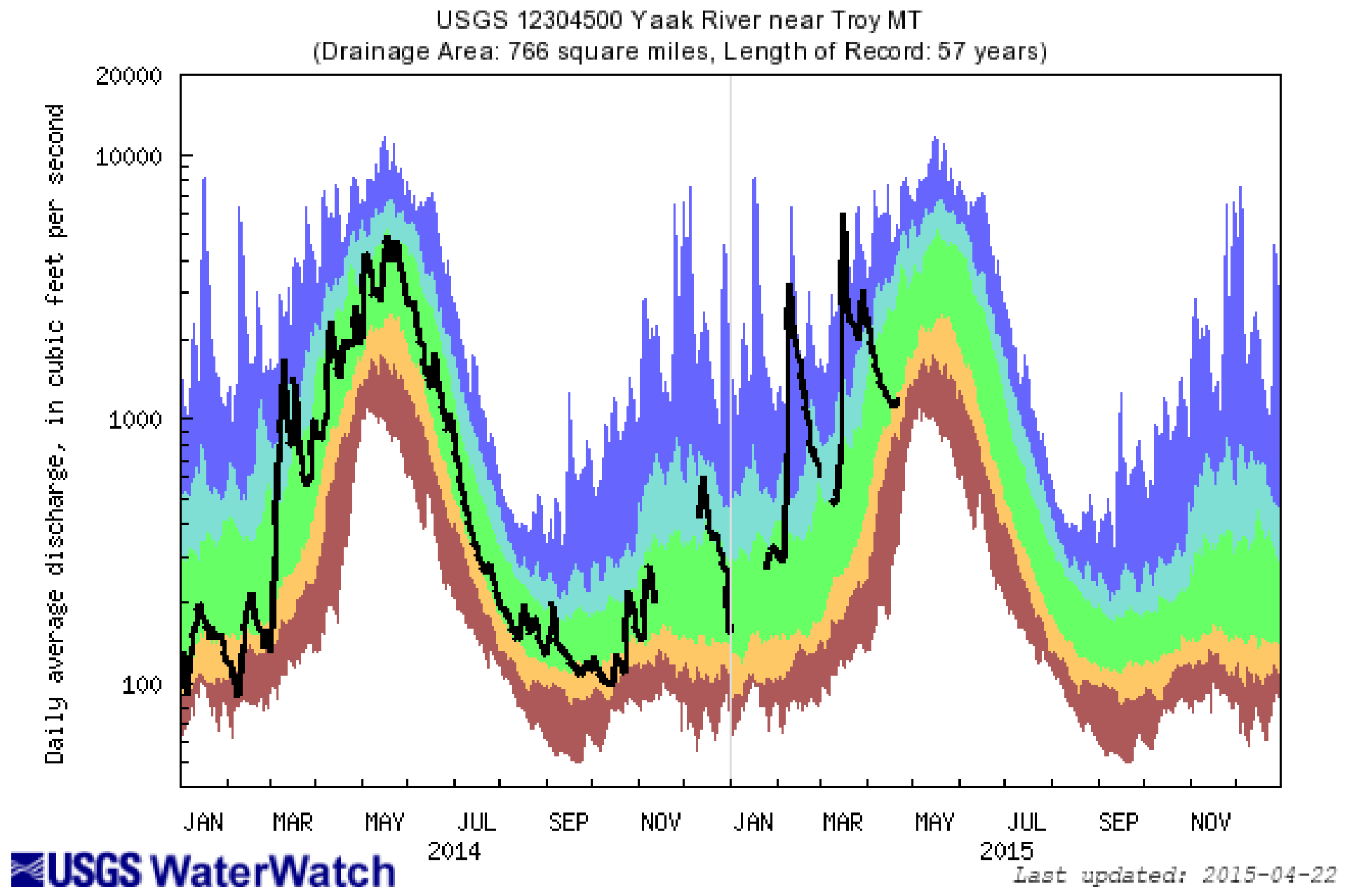
Current Streamflow Conditions, April 2015

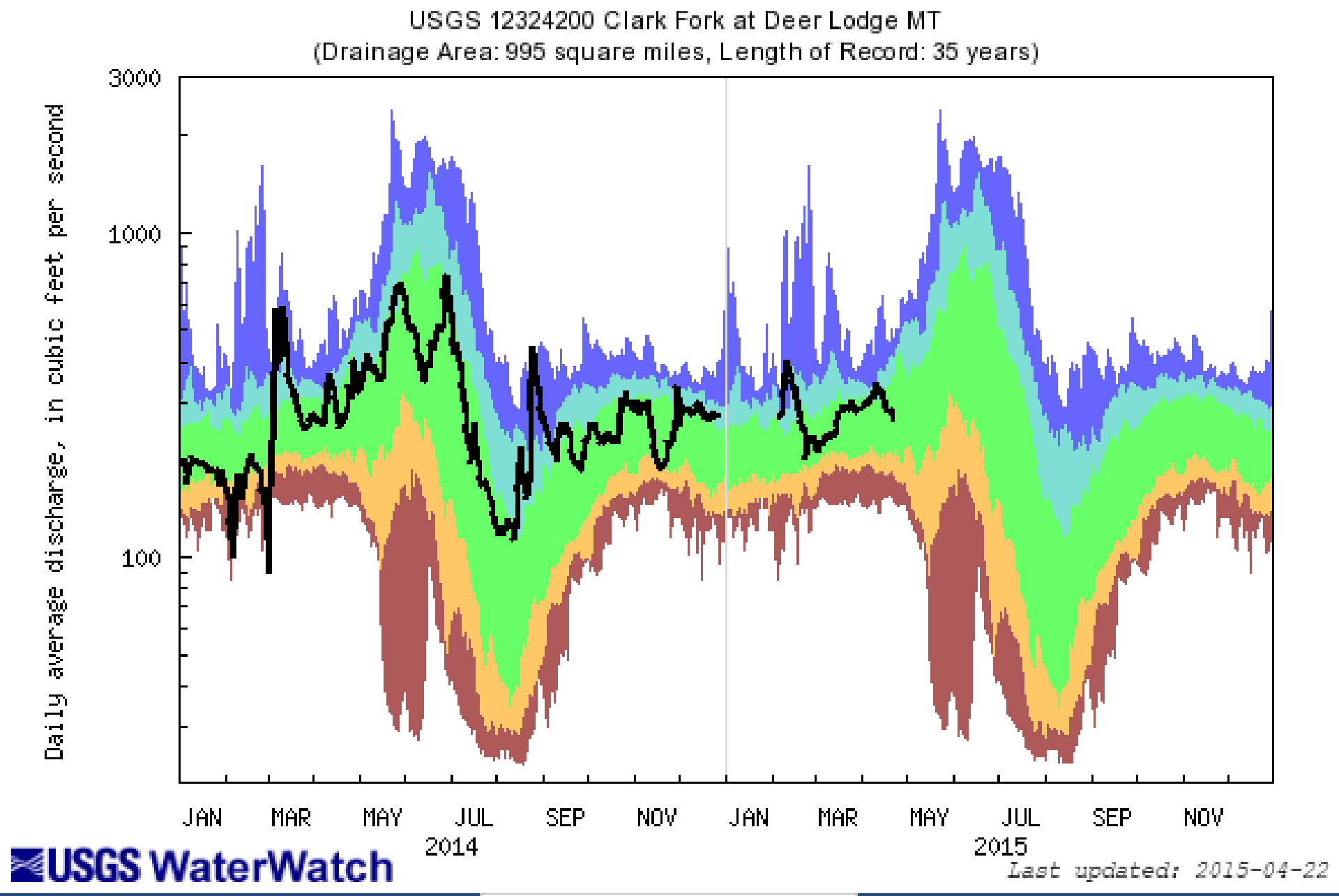
DAILY STREAMFLOW CONDITIONS

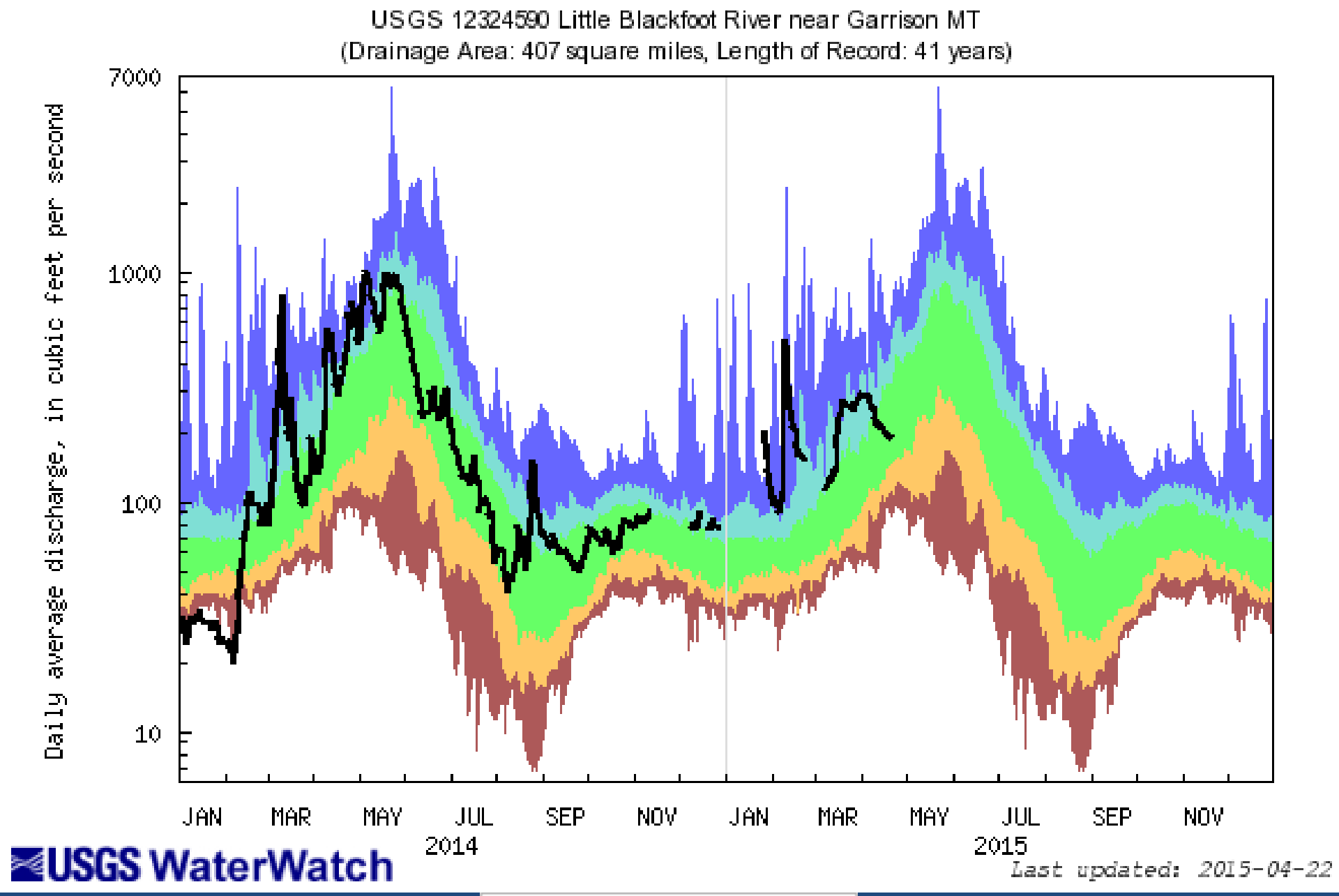


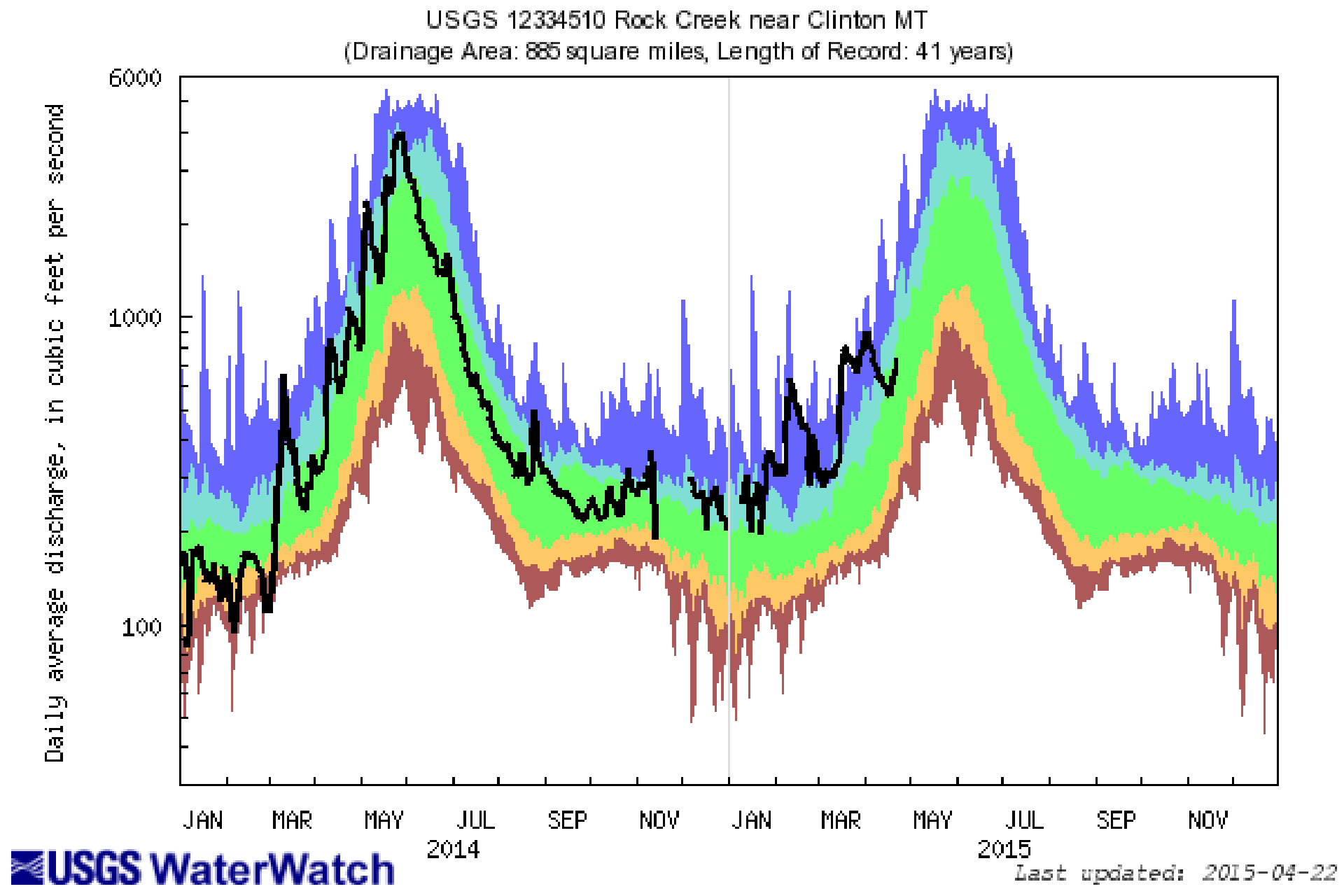

USGS 12301300 Tobacco River near Eureka MT
(Drainage Area: 440 square miles, Length of Record: 55 years)
Daily average discharge, in cubic feet per second
3000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

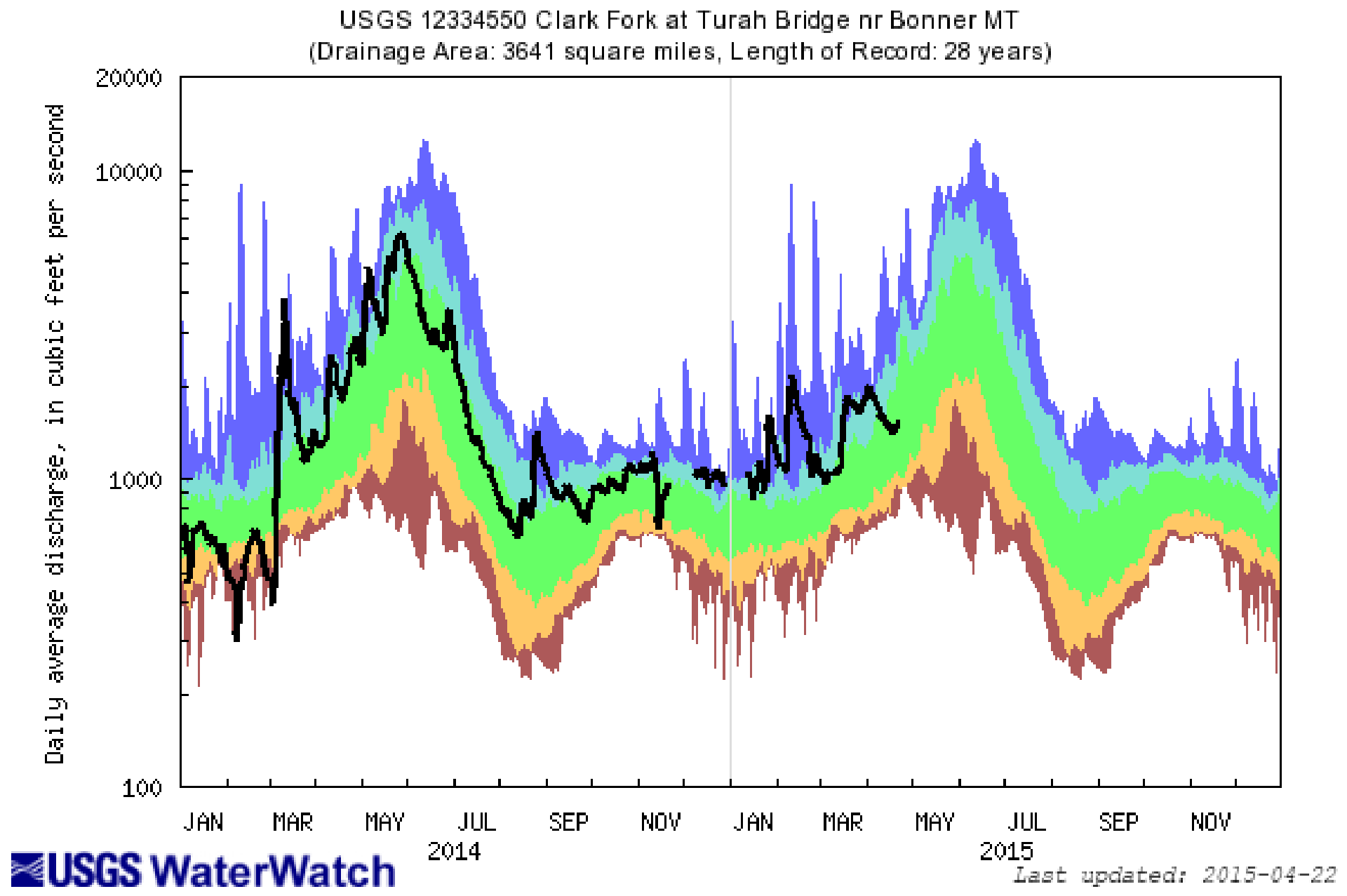

USGS 12302055 Fisher River near Libby MT
(Drainage Area: 838 square miles, Length of Record: 46 years)
Daily average discharge, in cubic feet per second
8000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

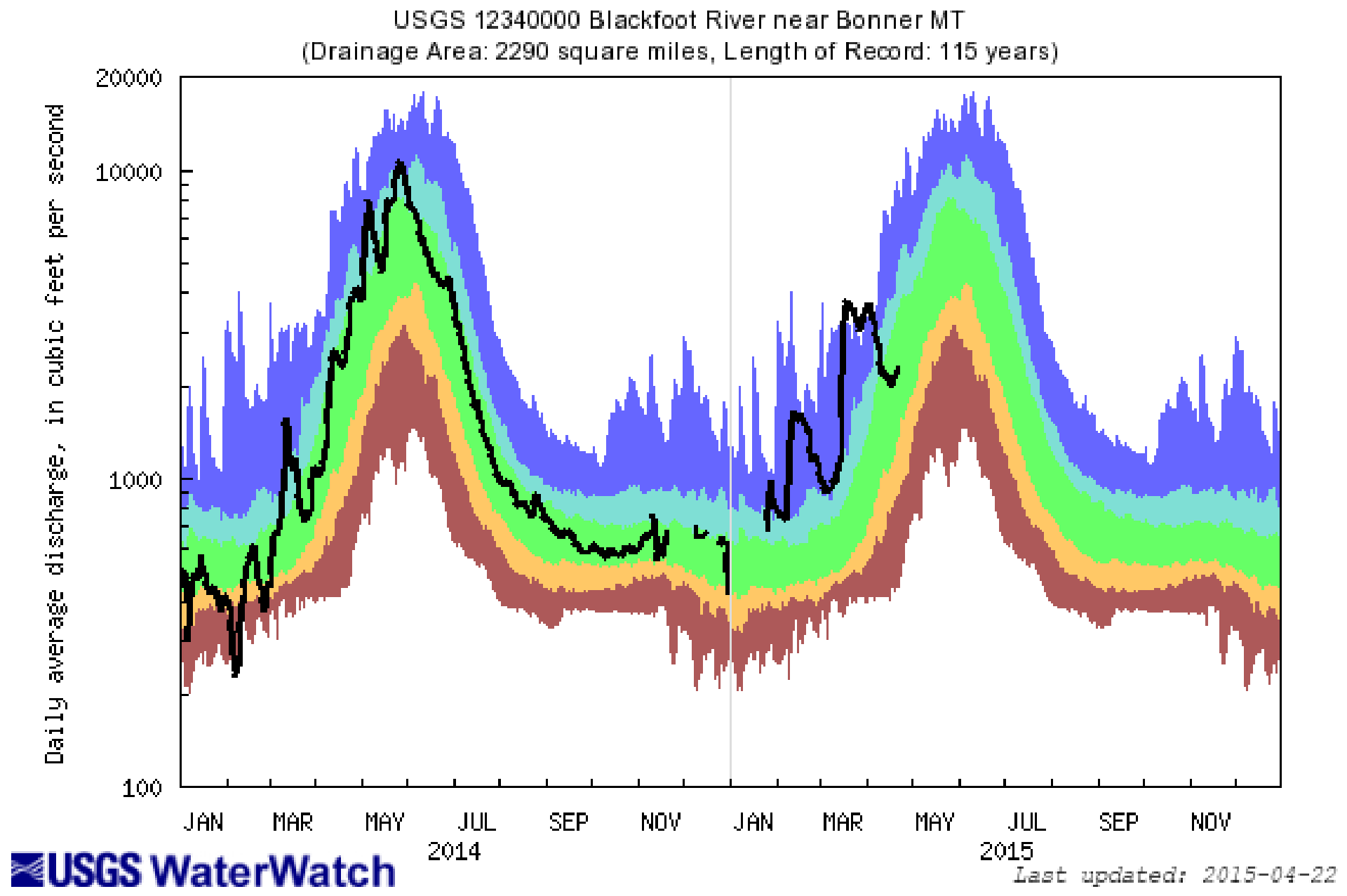

USGS 12304500 Yaak River near Troy MT
(Drainage Area: 766 square miles, Length of Record: 57 years)
Daily average discharge, in cubic feet per second
20000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

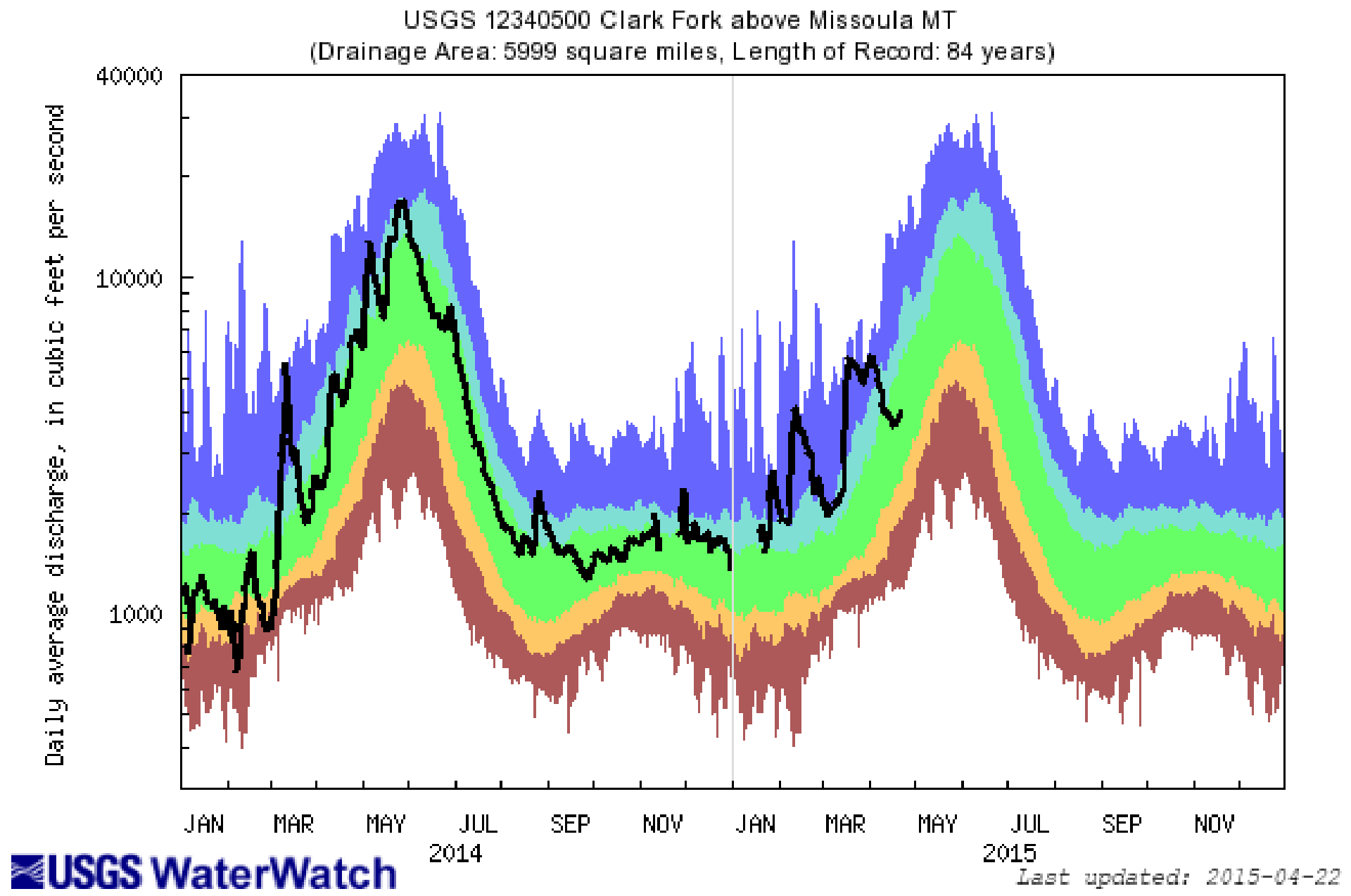

USGS 12324200 Clark Fork at Deer Lodge MT
(Drainage Area: 995 square miles, Length of Record: 35 years)
Daily average discharge, in cubic feet per second
3000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

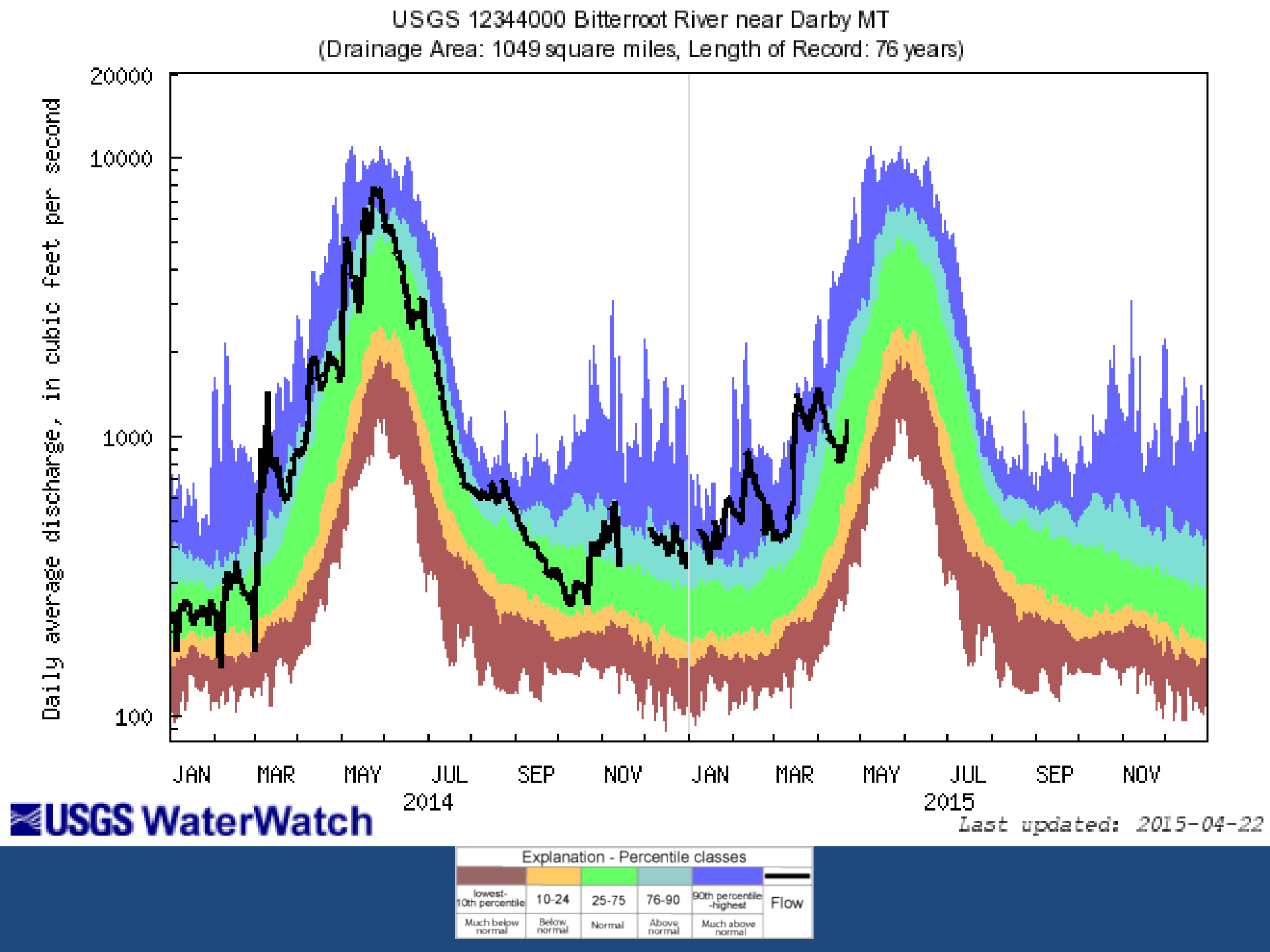

USGS 12324590 Little Blackfoot River near Garrison MT
(Drainage Area: 407 square miles, Length of Record: 41 years)
Daily average discharge, in cubic feet per second
7000
1000
100
10
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

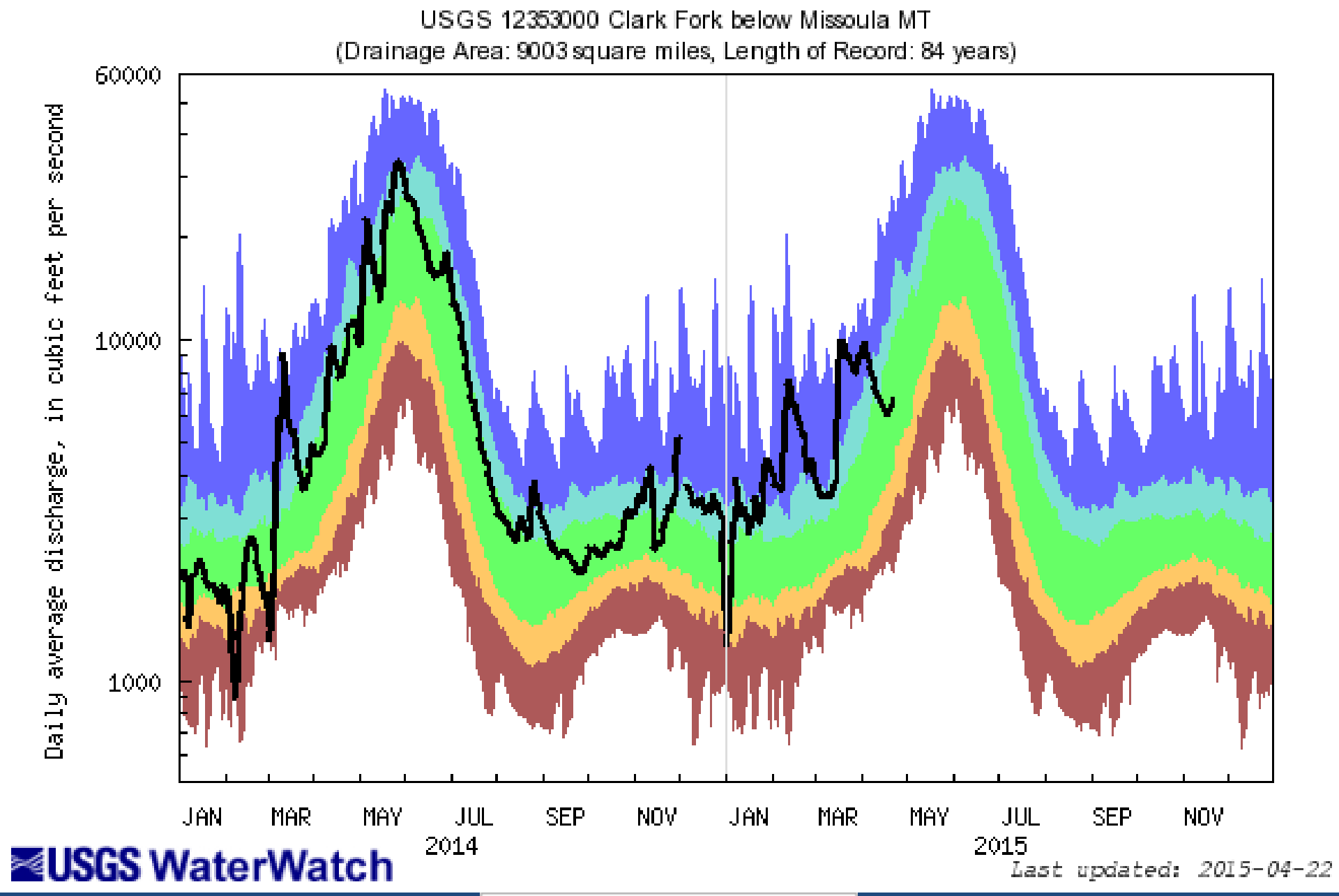

USGS 12334510 Rock Creek near Clinton MT
(Drainage Area: 885 square miles, Length of Record: 41 years)
Daily average discharge, in cubic feet per second
6000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

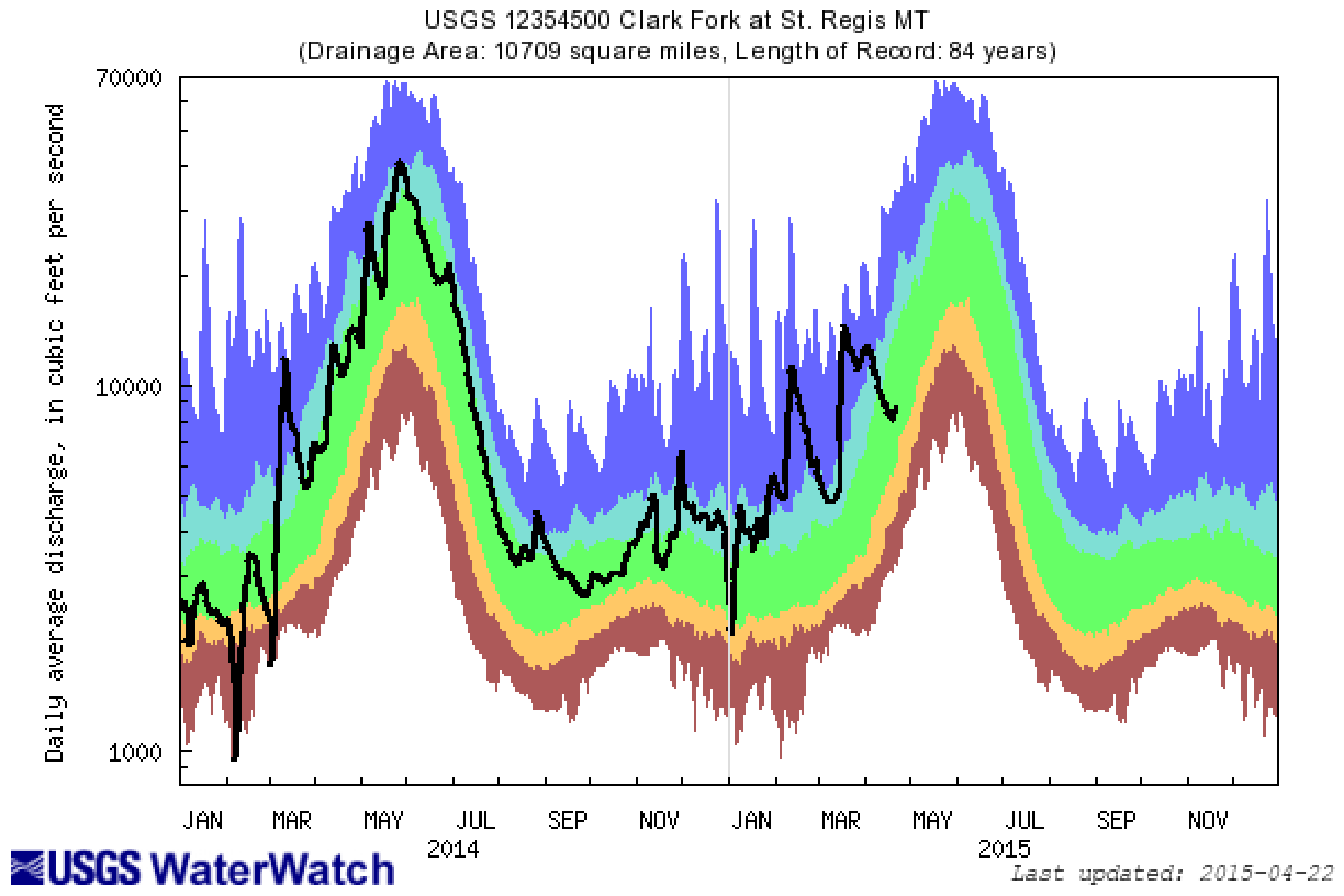

USGS 12334550 Clark Fork at Turah Bridge nr Bonner MT
(Drainage Area: 3641 square miles, Length of Record: 28 years)
Daily average discharge, in cubic feet per second
20000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

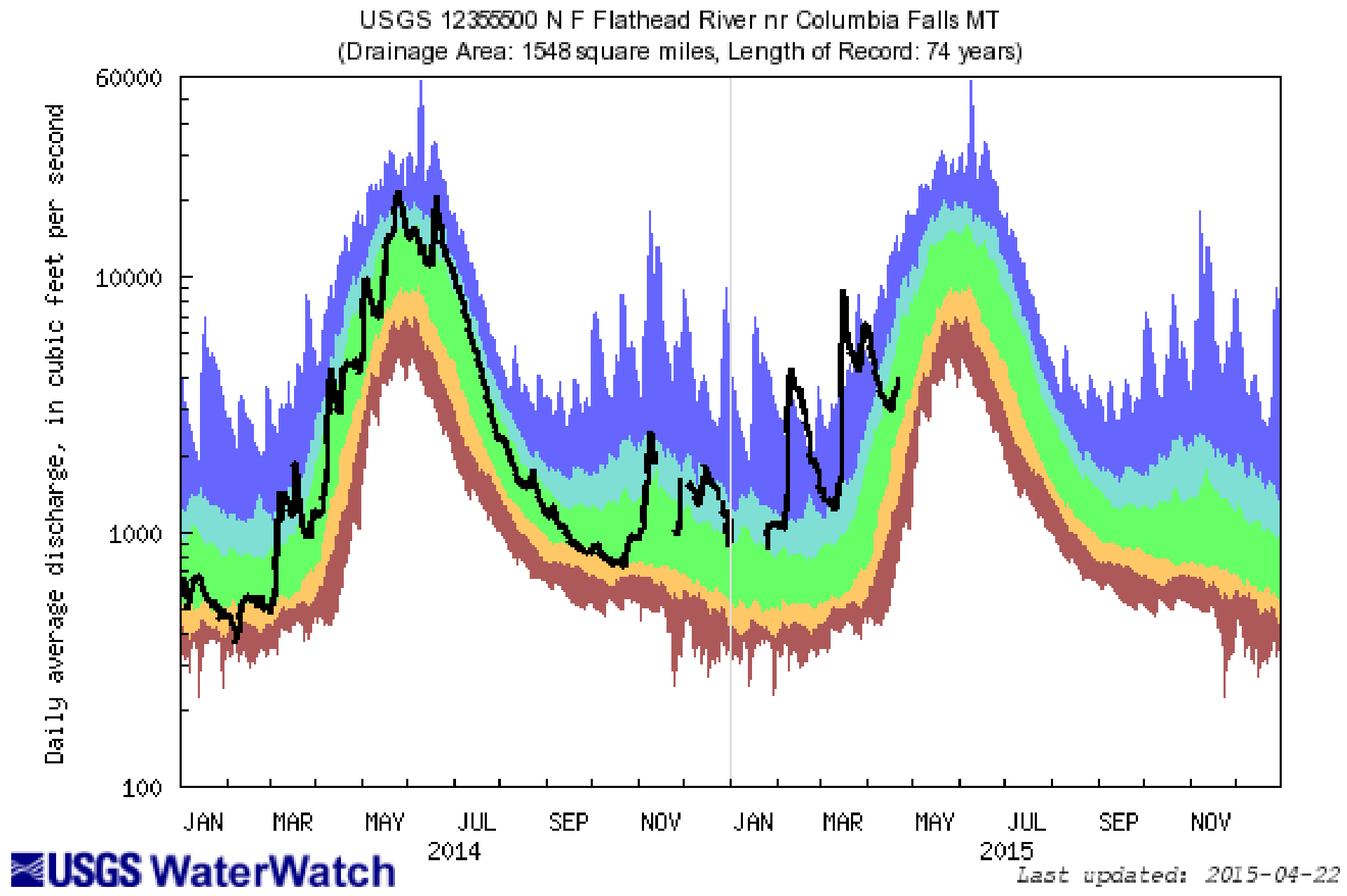

USGS 12340000 Blackfoot River near Bonner MT
(Drainage Area: 2290 square miles, Length of Record: 115 years)
Daily average discharge, in cubic feet per second
20000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

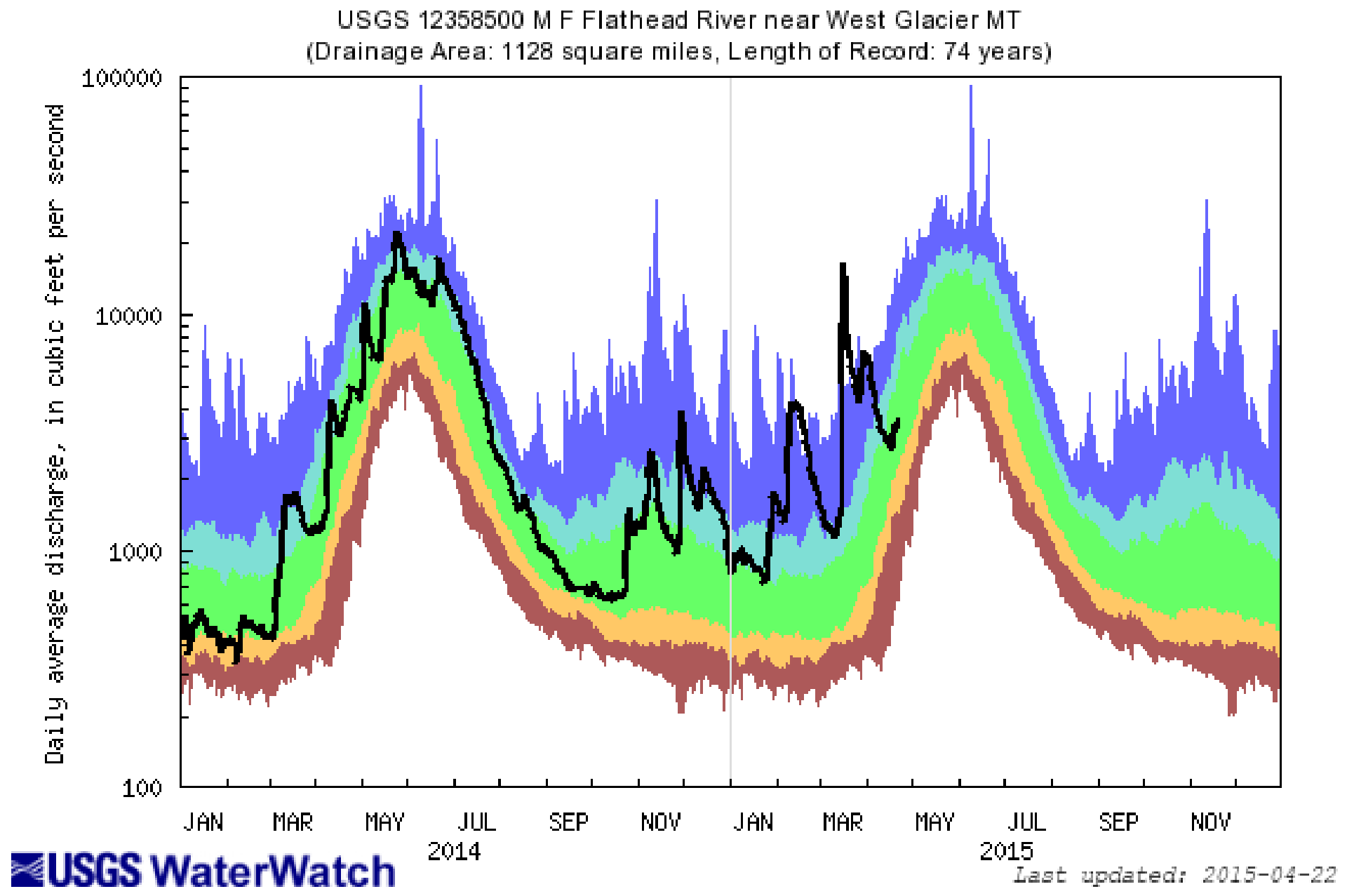

USGS 12340500 Clark Fork above Missoula MT
(Drainage Area: 5999 square miles, Length of Record: 84 years)
Daily average discharge, in cubic feet per second
40000
10000
1000
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

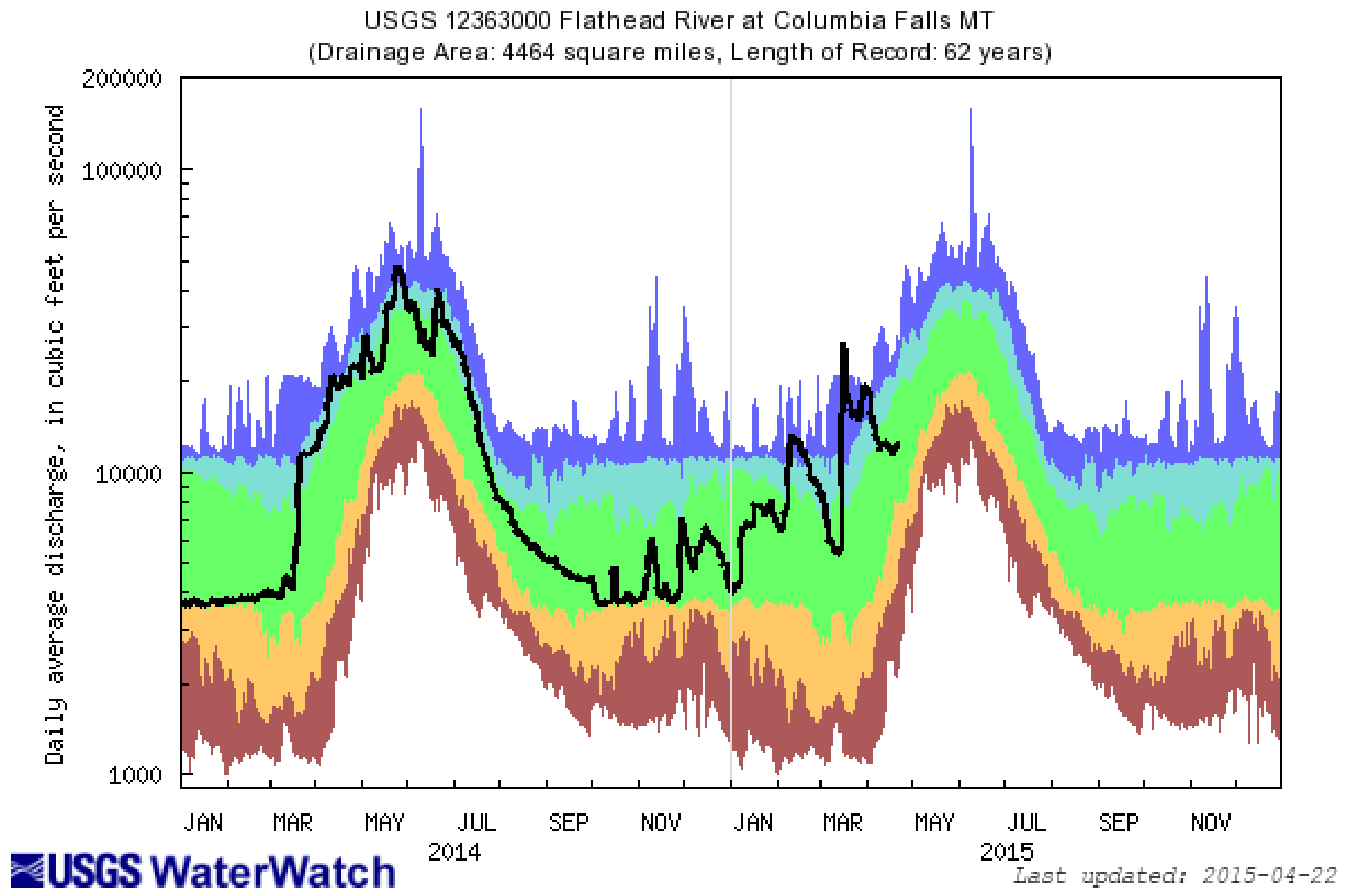

USGS 12344000 Bitterroot River near Darby MT
(Drainage Area: 1049 square miles, Length of Record: 76 years)
Daily average discharge, in cubic feet per second
20000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

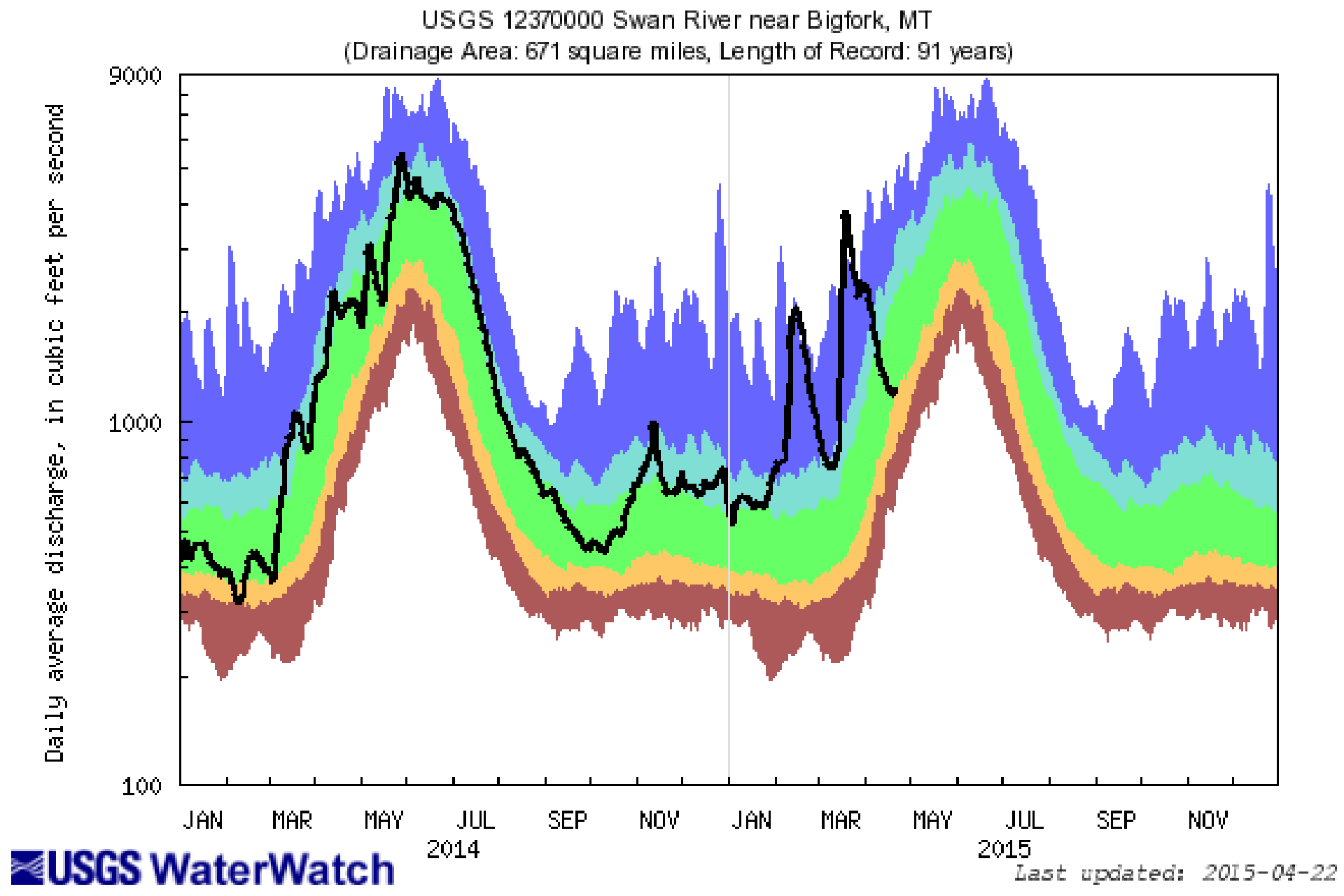

USGS 12353000 Clark Fork below Missoula MT
(Drainage Area: 9003 square miles, Length of Record: 84 years)
Daily average discharge, in cubic feet per second
60000
10000
1000
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

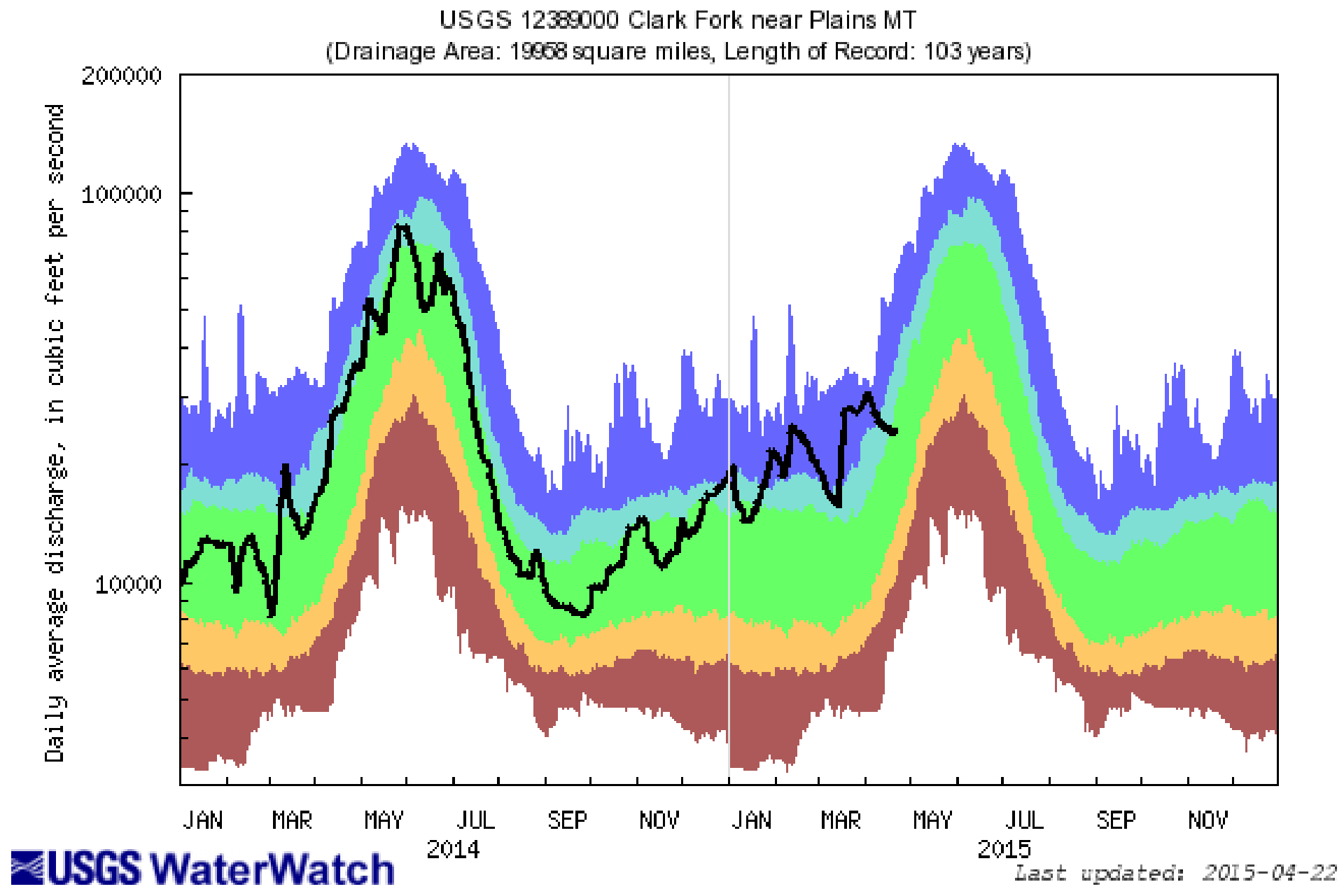

USGS 12354500 Clark Fork at St. Regis MT
(Drainage Area: 10709 square miles, Length of Record: 84 years)
Daily average discharge, in cubic feet per second
70000
10000
1000
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal

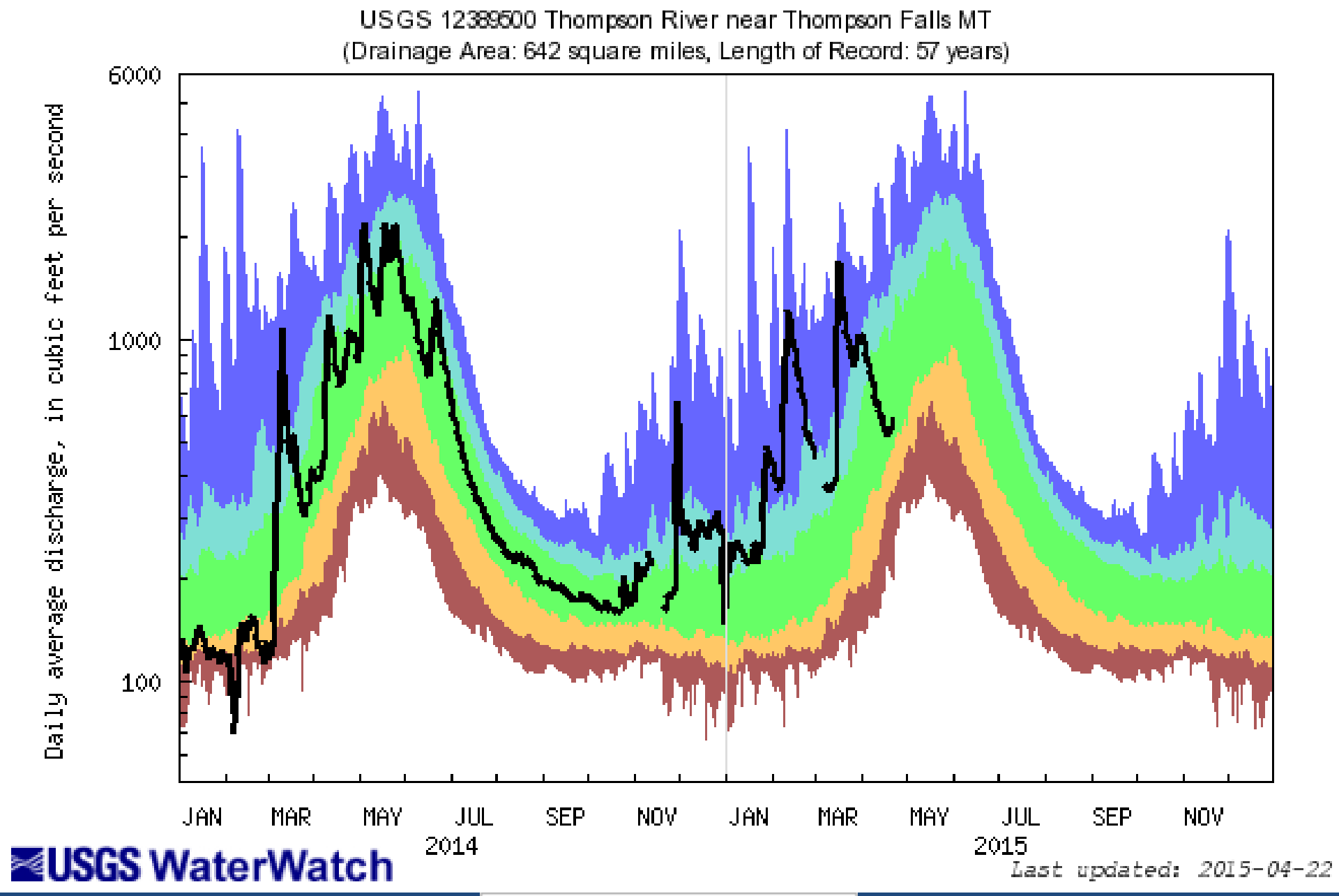

USGS 12355500 N F Flathead River nr Columbia Falls MT
(Drainage Area: 1548 square miles, Length of Record: 74 years)
Daily average discharge, in cubic feet per second
60000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal


USGS 12358500 M F Flathead River near West Glacier MT
(Drainage Area: 1128 square miles, Length of Record: 74 years)
Daily average discharge, in cubic feet per second
100000
10000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal


USGS 12363000 Flathead River at Columbia Falls MT
(Drainage Area: 4464 square miles, Length of Record: 62 years)
Daily average discharge, in cubic feet per second
200000
100000
10000
1000
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal


USGS 12370000 Swan River near Bigfork, MT
(Drainage Area: 671 square miles, Length of Record: 91 years)
Daily average discharge, in cubic feet per second
9000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal


USGS 12389000 Clark Fork near Plains MT
(Drainage Area: 19668 square miles, Length of Record: 103 years)
Daily average discharge, in cubic feet per second
200000
100000
10000
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
Last updated: 2015-04-22
Explanation - Percentile classes
lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal


USGS 12389500 Thompson River near Thompson Falls MT
(Drainage Area: 642 square miles, Length of Record: 57 years)
Daily average discharge, in cubic feet per second
6000
1000
100
JAN
MAR
MAY
JUL
SEP
NOV
JAN
MAR
MAY
JUL
SEP
NOV
2014
2015
USGS WaterWatch
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lowest-10th percentile
10-24
25-75
76-90
90th percentile-highest
Flow
Much below normal
Below normal
Normal
Above normal
Much above normal